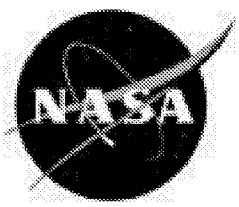
NASA/SP—2000–7037/SUPPL417
July 2000

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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Typical Report Citation and Abstract

❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10' to 50', and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65' swept forebody serrations tended to roll together, while vortices from 40' swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
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5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
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9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 417)

JULY 2000

01
AERONAUTICS (GENERAL)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft.

20000061405 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Automatic Inspection of Aircraft Using Open-Architecture Robotic Platforms
Bar–Cohen, Yoseph, Jet Propulsion Lab., California Inst. of Tech., USA; [1999]; 1p; In English; 8th, 22-26 Mar. 1999, Orlando, FL, USA; Sponsored by American Society for Nondestructive Testing, Inc., USA; No Copyright; Avail: Issuing Activity; Abstract Only

Aging aircraft structures and composite materials are requiring rapid inspection of large areas. Removal from the aircraft for NDE at an inspection facility is not economical as compared to field inspection. Detection and characterization of defects are labor intensive, time consuming and when the process is manual the results are subjected to human error. These limitations of NDE created a need for portable, user friendly inspection systems that can rapidly scan large areas of complex structures and locate all the detrimental material conditions. Addressing this need has been an evolutionary process that followed the technology trend, and unique devices were developed to allow rapid field inspection. This development involves multi-disciplinary approaches to integrate NDE, telerobotics, neural networks, advanced materials science, imbedded computing and automated control. These efforts have led to the development of various portable inspection systems and the current trend is towards fully automatic systems that will operate autonomously.
Author
Inspection; Evaluation; Aging (Materials); Aircraft Structures

20000061419 Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France
Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment ***la Conception et l'Optimisation Aerodynamiques des Vehicules Aeriens Dans un Environnement Pluridisciplinaire et Simultane***
Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000; 385p; In English, 18-21 Oct. 1999, Ottawa, Canada; See also 20000061420 through 20000061451; CD-ROM contains full text document in PDF format
Report No.(s): RTO-MP-35; AC/323(AVT)TP/15; ISBN 92-837-1040-1; Copyright Waived; Avail: CASI; A17, Hardcopy; A04, Microfiche; C01, CD-ROM

The Symposium dealt with Design Issues and more specifically Aerodynamic Design and Optimization of Flight Vehicles in a Concurrent Multi-Disciplinary Environment. Thirty two papers and a Keynote address were presented with the objective to survey the current and future scene given the trend towards a more concurrent and multi-disciplinary approach to aerospace vehicle engineering. There were six sessions covering the following topics: Lessons Learnt/Requirements for the Future Regard to the Role of Aerodynamicists in a Concurrent Multi-Disciplinary Design Process; The Role of Aerodynamics in Concept Phase of a Project Design; MDO and the Aerodynamics Design Process; Methodologies/Tools for Aerodynamic Optimisation; Application of Methodologies/Tools for Aerodynamic Optimisation; Techniques for Rapid Database Generation.
Author
Conferences; Aerodynamics; Design Analysis; Flight Optimization

20000064579 NASA Ames Research Center, Moffett Field, CA USA
Welcome to the NASA High Performance Computing and Communications Computational Aerosciences (CAS) Workshop 2000
Schulbach, Catherine H., Editor, NASA Ames Research Center, USA; Welcome to the NASA High Performance Computing and Communications Computational Aerosciences (CAS) Workshop 2000; February 2000; In English; 5th, 15-17 Feb. 2000, Moffett

Field, CA, USA; See also 20000064580 through 20000064627; CD-ROM contains full text document in PDF format
Contract(s)/Grant(s): RTOP 509-10-61
Report No.(s): D-000001; NONP-NASA-CD-2000078328; No Copyright; Avail: CASI; C01, CD-ROM

The purpose of the CAS workshop is to bring together NASA's scientists and engineers and their counterparts in industry, other government agencies, and academia working in the Computational Aerosciences and related fields. This workshop is part of the technology transfer plan of the NASA High Performance Computing and Communications (HPCC) Program. Specific objectives of the CAS workshop are to: (1) communicate the goals and objectives of HPCC and CAS, (2) promote and disseminate CAS technology within the appropriate technical communities, including NASA, industry, academia, and other government labs, (3) help promote synergy among CAS and other HPCC scientists, and (4) permit feedback from peer researchers on issues facing High Performance Computing in general and the CAS project in particular. This year we had a number of exciting presentations in the traditional aeronautics, aerospace sciences, and high-end computing areas and in the less familiar (to many of us affiliated with CAS) earth science, space science, and revolutionary computing areas. Presentations of more than 40 high quality papers were organized into ten sessions and presented over the three-day workshop. The proceedings are organized here for easy access: by author, title and topic.

Author

Conferences; Software Engineering; Supercomputers; Parallel Processing (Computers)

20000066622 Department of Defense, Office of the Inspector General, Arlington, VA USA

Low-Rate Initial Production of the EA-6B Program

Dec. 18, 1992; 54p; In English
Report No.(s): AD-A377218; IG/DOD-93-039; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Navy EA-6B aircraft performs the electronic warfare mission of suppression and degradation of enemy electronic defense systems by use of tactical jamming. The last new production EA-6B aircraft was delivered in 1989. The total program office cost estimate for the five contracts involved in developing a remanufactured upgrade of the aircraft was $761 million. The estimated total production cost for performing the remanufacture upgrade on 102 EA-6B aircraft is $6.8 billion.

DTIC

Electronic Warfare; Electronic Aircraft; Computer Program Integrity

20000070410 NASA Langley Research Center, Hampton, VA USA

Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplement 416

June 2000; 138p; In English
Report No.(s): NASA/SP-2000-7037/SUPPL416; NAS 1.21:7037/SUPPL416; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database. Records are arranged in categories: aeronautics, aerodynamics, air transportation and safety, aircraft communications and navigation, aircraft design, testing and performance, avionics and aircraft instrumentation, aircraft propulsion and power, aircraft stability and control, research and support facilities, astronautics, chemistry and materials, engineering, geosciences, mathematical and computer sciences, physics, social and information sciences, and space sciences.

CASI

Bibliographies; Aircraft Stability; Aircraft Instruments; Aircraft Engines; Aircraft Design; Aircraft Communication; Aerospace Engineering

02
AERODYNAMICS

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery.

20000058091 NASA Langley Research Center, Hampton, VA USA

1997 NASA High-Speed Research Program Aerodynamic Performance Workshop, Volume 1, Configuration Aerodynamics

Baize, Daniel G., Editor, NASA Langley Research Center, USA; December 1999; 806p; In English; Aerodynamic Performance, 25-28 Feb. 1997, Hampton, VA, USA; See also 20000058092 through 20000058109; Original contains color illustrations
Contract(s)/Grant(s): RTOP 537-07-00

Report No.(s): NASA/CP-1999-209691/VOL1/PT1; L-17916B; NAS 1.55:209691/VOL1/PT1; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

The High-Speed Research Program and NASA Langley Research Center sponsored the NASA High-Speed Research Program Aerodynamic Performance Workshop on February 25-28, 1997. The workshop was designed to bring together NASA and industry High-Speed Civil Transport (HSCT) Aerodynamic Performance technology development participants in area of Configuration Aerodynamics (transonic and supersonic cruise drag prediction and minimization), High-Lift, Flight Controls, Supersonic Laminar Flow Control, and Sonic Boom Prediction. The workshop objectives were to (1) report the progress and status of HSCT aerodynamic performance technology development; (2) disseminate this technology within the appropriate technical communities; and (3) promote synergy among the scientist and engineers working HSCT aerodynamics. In particular, single- and multi-point optimized HSCT configurations, HSCT high-lift system performance predictions, and HSCT Motion Simulator results were presented along with executive summaries for all the Aerodynamic Performance technology areas.
Author

Aerodynamic Characteristics; Aerodynamic Configurations; Civil Aviation; Supersonic Transports

20000058092 McDonnell-Douglas Corp., Long Beach, CA USA

Overview of MDC Configuration Aerodynamics Activities

Agrawal, Shreekant, McDonnell-Douglas Corp., USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 1-4; In English; See also 20000058091; No Copyright; Avail: CASI; A01, Hardcopy; A10, Microfiche

This paper presents an Overview of MDC (McDonnell Douglas Corporation) Configuration Aerodynamic Activities. Listed are subtask descriptions of MDC under PCD (Planning and Control Document) II. The topics include: 1) Nonlinear Rigid and Aeroelastic Analysis Methods; 2) Aerodynamic Design Optimization Capability; 3) Nacelle/Diverter Design and Airframe Integration; and 4) Technology Concept Assessment.
CASI

Aerodynamic Configurations; Aerodynamic Characteristics

20000058093 McDonnell-Douglas Aerospace, Long Beach, CA USA

Enhancements of CFL3Dhp Parallel Code and Its HSR Applications

Sundaram, P., McDonnell-Douglas Aerospace, USA; Novean, Mike, McDonnell-Douglas Aerospace, USA; Cheung, Samson, McDonnell-Douglas Aerospace, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 5-43; In English; See also 20000058091; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper presents the recent progress made and the results obtained in the area of parallel computing for the CFD analysis of large HSR configurations. The code used for the present study is CFL3Dhp, a coarse-grain parallel version of the MDC Configuration Aerodynamics group work-horse Euler/Navier-Stokes analysis and nonlinear design code, CFL3D. The original parallelization of the code was carried out by Computer Sciences Corporation under contract from NASA LaRC. The parallel version of the code uses MPI as the message passing language an d can be used in a heterogeneous distributed computing environment. Several enhancements to the code have been made at MDC including the addition of a full restart capability as well as making it more user friendly. The successful application of the code on a parallel platform, the IBM SP-2 system for several HSCT configurations are demonstrated. Also, the application of the code on other shared memory platforms such as Cray C-90 and the J-90 cluster are also highlighted. The results obtained show the promise of using this code for large CFD problems in HSCT analysis and design with rapid turn-around.
Author

Computational Fluid Dynamics; Parallel Processing (Computers); Supersonic Transports; Applications Programs (Computers); Civil Aviation; Body-Wing Configurations; Augmentation

20000058094 McDonnell-Douglas Corp., Long Beach, CA USA

Full Configuration Force and Moment Calculations Using Multiblock CFL3D on HSCT Configurations

Martin, Grant L., McDonnell-Douglas Corp., USA; Narducci, Robert P., McDonnell-Douglas Corp., USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 44-114; In English; See also 20000058091; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

During the past year, the McDonnell Douglas Corporation (MDC) has made large strides in Computational Fluid Dynamics (CFD) analysis of increasingly complex HSCT configurations using both serial and parallel computational platforms. While tools for grid generation and analysis on serial computers have remained relatively unchanged, a new gridding strategy has been

employed to obtain Navier-Stokes analyses of HSCT configurations which include the wing, body, nacelles, diverters, and empennage. Additionally, with the promising efficiency of parallel machines, MDC has contributed to the development of CFL3Dhp, a parallel version of CFL3D for the IBM SP-2. Presented herein are full configuration Euler and Navier-Stokes solutions obtained using CFL3D on the NAS C-90 and IBM SP-2. With the objectives of validating CFL3D for supersonic cruise calculations on several platforms, CFD results for the Reference H and Technology Concept Airplane (TCA) configurations are presented in a build-up fashion. The build-up fashion entails analyzing the simplest of configuration first, the wing/body (W/B) followed by the additional complexity of the empennage (W/B/E), then nacelles and diverters (W/B/N/D), and finally the entire configuration (W/B/N/D/E). A thorough build-up has been performed on the Reference H configuration, while the TCA build-up work is still in progress. To assist in the validation, a number of comparisons are made to available experimental data from the NASA Langley Unitary Plan Wind Tunnel (UPWT).
Derived from text
Civil Aviation; Computational Fluid Dynamics; Multiblock Grids; Applications Programs (Computers); Wind Tunnel Models; Body-Wing and Tail Configurations; Loads (Forces); Pitching Moments

20000058096 McDonnell-Douglas Corp., Long Beach, CA USA
Improvements to the MDC Nonlinear Aerodynamic Design Tools
Hager, James O., McDonnell-Douglas Corp., USA; Hartwich, Peter M., McDonnell-Douglas Corp., USA; Unger, Eric R., McDonnell-Douglas Corp., USA; Kuruvila, Geojoe, McDonnell-Douglas Corp., USA; Narducci, Robert P., McDonnell-Douglas Corp., USA; Agrawal, Shreekant, McDonnell-Douglas Corp., USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 189-254; In English; See also 20000058091; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Nonlinear aerodynamic optimization is considered a key technology required to develop a High Speed Civil Transport (HSCT). Within the High Speed Research (HSR) program, McDonnell Douglas is developing nonlinear optimization tools to be able to support the launch of an HSCT program at the end of HSR II. This paper presents recent improvements to the tools. The first set of improvements were made to be able to optimize the Technology Concept Aircraft (TCA). The TCA presented some grid generation issues because it is a true low-wing configuration. In addition, several constraints were required to maintain a realistic design. Second, the geometry modeling capability was improved to move toward full-configuration modeling. Empennage effects have been modeled, and wing/body/flaps configurations can be modeled. Efforts were also made to produce and improve tools required for integrated wing/body/nacelle/diverter modeling. Third, alternate gradient evaluation techniques are being examined to replace the finite-difference calculations currently being used. ADIFOR was applied to CFL3D and demonstrated for a 100+ design-variable problem. Also, an adjoint module is being created for TLNS3D. Finally, A transition is being made to a modular design environment to facilitate improvements and the addition of new codes.
Derived from text
Civil Aviation; Design Analysis; Nonlinearity; Supersonic Transports; Aircraft Models; Applications Programs (Computers)

20000058098 McDonnell-Douglas Aerospace, Saint Louis, MO USA
Isolated and Installed Nozzle Boattail Drag Studies
Wallace, Hoyt, McDonnell-Douglas Aerospace, USA; Sundaram, P., McDonnell-Douglas Aerospace, USA; Arslan, Alan E., McDonnell-Douglas Aerospace, USA; Shieh, Chih Fang, McDonnell-Douglas Aerospace, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 305-375; In English; See also 20000058091; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

As part of the FY95 transonic nozzle boattail drag study for the Reference H configuration, the McDonnell Douglas (MDC) task included the axisymmetric nozzle assessment while Northrop Grumman (NGC) studied the 2-D nozzle geometry. The 2-D nozzle was a simulation of the baseline nozzle as of March 1995, while the axisymmetric nozzle was the equivalent body of revolution. Boattail settings representing transonic operation (i.e., small exit area) and the wide-open, supersonic reference nozzle were analyzed. During the course of the investigation, significant difficulties were experienced and hence the results of the axisymmetric supersonic nozzle geometry could not be obtained. As a result, the study was continued (although with minimal effort) this past year to complete the axisymmetric nozzle geometry. A new grid was generated with a modified topology, first for the installed axisymmetric supersonic nozzle configuration and later for the axisymmetric transonic nozzle (solution repeated for consistency) configuration. After successfully obtaining the CFL3D Navier-Stokes results for the axisymmetric installed nozzle geometry at M (sub infinity) = 0.9, the study was continued for the 2-D installed transonic nozzle configuration as well, to ensure consistency in the comparison of the axisymmetric and 2-D nozzle results. Solutions for the four isolated nacelles have been obtained at both Mach 0.9 and 1.10. The solutions for the installed axisymmetric supersonic nozzle configuration at Mach 1.10 and for the 2-D installed transonic nozzle configuration at either Mach 0.9 or Mach 1.10 have not been obtained as of this

writing. However, the results to date indicated the following: (1) the drag of the isolated axisymmetric transonic nozzle was slightly less that that of the 2-D nozzle at both Mach 0.9 and 1.10; (2) the interference drag for both the axisymmetric and 2-D nacelles are nearly identical at Mach 0.90.
Author
Computational Fluid Dynamics; Nozzle Geometry; Boattails; Two Dimensional Flow; Wind Tunnel Tests; Transonic Nozzles; Civil Aviation; Aerodynamic Drag

20000058105 NASA Langley Research Center, Hampton, VA USA
Prediction and Assessment of Reynolds Number Sensitivities Associated with Wing Leading-Edge Radius Variations
Wahls, Richard A., NASA Langley Research Center, USA; Rivers, Melissa B., NASA Langley Research Center, USA; Owens, Lewis R., Jr., NASA Langley Research Center, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 588-611; In English; See also 20000058091; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The primary objectives of this study were to expand the data base showing the effects of LE radius distribution and corresponding sensitivity to Rn at subsonic and transonic conditions, and to assess the predictive capability of CFD for these effects. Several key elements led to the initiation of this project: 1) the necessity of meeting multipoint design requirements to enable a viable HSCT, 2) the demonstration that blunt supersonic leading-edges can be associated with performance gain at supersonic speeds , and 3) limited data. A test of a modified Reference H model with the TCA planform and 2 LE radius distributions was performed in the NTF, in addition to Navier-Stokes analysis for an additional 3 LE radius distributions. Results indicate that there is a tremendous potential to improve high-lift performance through the use of a blunt LE across the span given an integrated, fully optimized design, and that low Rn data alone is probably not sufficient to demonstrate the benefit.
Derived from text
Computational Fluid Dynamics; Leading Edges; Prediction Analysis Techniques; Reynolds Number; Sensitivity; Radii; Supersonic Transports; Wings

20000058106 NASA Langley Research Center, Hampton, VA USA
Preliminary Results of the 1.5% TCA (Modular) Controls Model in the NASA Langley UPWT
Kubiatko, Paul, McDonnell-Douglas Aerospace, USA; McMillin, Naomi, NASA Langley Research Center, USA; Cameron, Douglas C., McDonnell-Douglas Aerospace, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 612-668; In English; See also 20000058091; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

To summarize the significant highlights in this report: (1) Data quality, determined by multiple repeat runs performed on the TCA baseline configuration, and long-term repeatability, determined by comparing baseline Reference H data from this test to a previous test, have been shown to be good. (2) The longitudinal stability of the TCA is more non-linear than for the Reference H, and while it is similar at normal lift values, the TCA has considerably more pitch-up at higher lift. (3) Longitudinal control effectiveness of the TCA is similar to the Reference H and the ratio of elevator effectiveness to horizontal tail effectiveness is approximately 0.3. (4) The directional stability of the TCA is improved relative to Reference H at higher angles-of attack. The chine is effective for improving directional stability.
Derived from text
Controllability; Directional Stability; Wind Tunnel Tests; Aircraft Models; Aerodynamic Characteristics; Civil Aviation

20000058107 NASA Langley Research Center, Hampton, VA USA
Effect of Boattail and Sidewall Curvature on Nozzle Drag Characteristics
Capone, Francis J., NASA Langley Research Center, USA; Deere, Karen A., NASA Langley Research Center, USA; Bangert, Linda S., NASA Langley Research Center, USA; Pao, Paul S., NASA Langley Research Center, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 669-706; In English; See also 20000058091; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The NASA-industry team has sponsored several studies in the last two years to address the installed nozzle boattail drag issues. Some early studies suggested that nozzle boattail drag could be as much as 25 to 40 percent of the subsonic cruise. As part of this study tests have been conducted at NASA-Langley to determine the uninstalled drag characteristics of a proposed nozzle. The overall objective was to determine the effects of nozzle external flap curvature and sidewall boattail variations. This test would also provide data for validating CFD predictions of nozzle boattail drag.
Derived from text
Boattails; Computational Fluid Dynamics; Curvature; Aerodynamic Drag; Nozzle Geometry; Aerodynamic Characteristics

20000058109 McDonnell-Douglas Aerospace, Long Beach, CA USA
Comparison of Linearized Potential Flow Design and Analysis Codes
Morgenstern, John, McDonnell-Douglas Aerospace, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 729-776; In English; See also 20000058091; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The purpose of this task is to compare high speed aerodynamics design methods to find the most accurate and consistent methods for use in HSR Technology Integration studies. In order to compare design methods for Technology Integration, we first separate drag into the components that each method predicts. CD Friction process differences have been quantified and should not affect drag trends between designs; therefore, the differences are considered acceptable. Based on previous work, differences in CD Wave were relatively small and probably due to differences in the geometry analyzed and the number of cuts used--process improvements are still under investigation. CD Induced and ACD Nacelles were known to have the largest differences, so the most effort has been concentrated in those two areas. This paper discusses only the CD Induced results.
Derived from text
High Speed; Potential Flow; Aircraft Design; Computational Fluid Dynamics; Linearization; Applications Programs (Computers)

20000059225 NASA Langley Research Center, Hampton, VA USA
Review of Skin Friction Measurements Including Recent High-Reynolds Number Results from NASA Langley NTF
Watson, Ralph D., NASA Langley Research Center, USA; Hall, Robert M., NASA Langley Research Center, USA; Anders, John B., NASA Langley Research Center, USA; [2000]; 24p; In English; Fluids, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-2392; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper reviews flat plate skin friction data from early correlations of drag on plates in water to measurements in the cryogenic environment of The NASA Langley National Transonic Facility (NTF) in late 1996. The flat plate (zero pressure gradient with negligible surface curvature) incompressible skin friction at high Reynolds numbers is emphasized in this paper, due to its importance in assessing the accuracy of measurements, and as being important to the aerodynamics of large scale vehicles. A correlation of zero pressure gradient skin friction data minimizing extraneous effects between tests is often used as the first step in the calculation of skin friction in complex flows. Early data compiled by Schoenherr for a range of momentum thickness Reynolds numbers, R(sub Theta) from 860 to 370,000 contained large scatter, but has proved surprisingly accurate in its correlated form. Subsequent measurements in wind tunnels under more carefully controlled conditions have provided inputs to this database, usually to a maximum R(sub Theta) of about 40,000. Data on a large axisymmetric model in the NASA Langley National Transonic Facility extends the upper limit in incompressible R(sub Theta) to 619,800 using the van Driest transformation. Previous data, test techniques, and error sources ar discussed, and the NTF data will be discussed in detail. The NTF Preston tube and Clauser inferred data accuracy is estimated to be within -2 percent of a power-law curve fit, and falls above the Spalding theory by 1 percent at R(sub Theta) of about 600,000.
Author
Skin Friction; Friction Measurement

20000060814 Federal Aviation Administration, John A Volpe National Transportation Systems Center, Cambridge, MA USA
Performance of RASS Vortex Detection/Measurement System
Jun. 1999; 40p; In English
Report No.(s): AD-A368345; DOT-VNTSC-FAA-99-10; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The purpose of this report was to analyze and validate the longitudinal and transverse mode Radio Acoustic Sounding System (RASS) capabilities: to indicate vortex presence in the flight path during a variety of meteorological conditions; and to track a vortex or pair of vortices during a variety of meteorological conditions.
DTIC
Atmospheric Sounding; Vortices; Sound Detecting and Ranging; Acoustic Sounding

20000060820 NASA Langley Research Center, Hampton, VA USA
Biomimetic Flow Control
Anders, John B., NASA Langley Research Center, USA; [2000]; 28p; In English; Fluids, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-2543; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Biologic flight has undoubtedly intrigued man for thousands of years, yet it has been only the last 100 years or so that any serious challenge has been mounted to the pre-eminence of birds. Although present-day large-scale aircraft are now clearly able to fly higher, faster and farther than any bird or insect, it is obvious that these biological creatures have a mastery of low Reynolds number, unsteady flows that is unrivaled by man-made systems. This paper suggests that biological flight should be examined for mechanisms that may apply to engineered flight systems, especially in the emerging field of small-scale, uninhabited aerial vehicles (UAV). This paper discusses the kinematics and aerodynamics of bird and insect flight, including some aspects of unsteady aerodynamics. The dynamics of flapping wing flight is briefly examined, including gait selection, flapping frequency and amplitude selection, as well as wing planform and angle-of-attack dynamics. Unsteady aerodynamic mechanisms as practiced by small birds and insects are reviewed. Drag reduction morphologies of birds and marine animals are discussed and fruitful areas of research are suggested.
Author
Marine Biology; Flow Velocity; Unsteady Aerodynamics; Kinematics

20000060836 NASA Langley Research Center, Hampton, VA USA
Aeroelastic Deformation Measurements of Flap, Gap, and Overhang on a Semispan Model
Burner, A. W., NASA Langley Research Center, USA; Liu, Tianshu, NASA Langley Research Center, USA; Garg, Sanjay, High Technology Corp., USA; Ghee, Terence A., Naval Air Systems Command, USA; Taylor, Nigel J., Defence Evaluation Research Agency, UK; [2000]; 16p; In English; 21st; Aerodynamic Measurement Technology and Ground Testing, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-2386; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Single-camera, single-view videogrammetry has been used to determine static aeroelastic deformation of a slotted flap configuration on a semispan model at the National Transonic Facility (NTF). Deformation was determined by comparing wind-off to wind-on spatial data from targets placed on the main element, shroud, and flap of the model. Digitized video images from a camera were recorded and processed to automatically determine target image plane locations that were then corrected for sensor, lens, and frame grabber spatial errors. The videogrammetric technique has been established at NASA facilities as the technique of choice when high-volume static aeroelastic data with minimum impact on data taking is required. The primary measurement at the NTF with this technique in the past has been the measurement of static aeroelastic wing twist on full span models. The first results using the videogrammetric technique for the measurement of component deformation during semispan testing at the NTF are presented.
Author
Aeroelasticity; Deformation; Flapping; Semispan Models; Static Deformation; Wing Span

20000061420 British Aerospace Public Ltd. Co., Military Aircraft and Aerostructures, Warton, UK
Eurofighter: Aerodynamics within a Multi-Disciplinary Design Environment
McKay, Keith, British Aerospace Public Ltd. Co., UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 1-1 - 1-10; In English; See also 20000061419; Copyright Waived; Avail: CASI; A02, Hardcopy

The art and science of aerodynamics have been developing continually to meet the changing needs of aircraft of all types, in many cases, combat aircraft design drives this development farther and faster in the search for improved combat effectiveness. One result has been that an ever broadening of the individual but heavily integrated aspects of aerodynamics into a set of interdependent, diverse fields, covering fluid dynamics, structural dynamics, solid body mechanics, ballistics, acoustics and more recently electro-magnetics. Together, these individual disciplines are combined together into a term sometimes referred to as aerodynamic technology, as described in a recent Royal Aeronautical Society edition. This paper will examine the requirements placed upon these disciplines in the light of the multi-disciplinary design optimisation process that took place on the Eurofighter project, specifically highlighting the roles of the aerodynamic technologies within that process and the lessons learned from their application in this environment. The paper will also provide some recommendations for improvements in the design capabilities based upon the experience gained and lessons learned from the design of the Eurofighter Weapon System.
Author
Aerodynamics; Aircraft Design; Dynamic Structural Analysis

20000061432 British Aerospace Public Ltd. Co., Military Aircraft and Aerostructures, Warton, UK
An MDO Application for a Weapon Released from an Internal Bay
Moretti, G., British Aerospace Public Ltd. Co., UK; Spicer, D., British Aerospace Public Ltd. Co., UK; Sharples, N., British Aerospace Public Ltd. Co., UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary

Environment; June 2000, pp. 14-1 - 14-12; In English; See also 20000061419; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

Multi Disciplinary Optimisation (MDO) process has always been identified as an essential tool for the development of an aircraft design. Recent engineering emphasis has been on improving the depth of optimisation within a reduced overall time frame, a goal which depends on the level of automation available and the capability and skill of each discipline. The figure below shows an overview of the general design cycle in the military aircraft manufacturer's world. The large time spans involved in the full process should be appreciated: it may take between ten and twenty years to bring a new project to fruition.
Author

Optimization; Aircraft Design; Procedures

20000061433 Pisa Univ., Dipartimento di Ingegneria Aerospaziale, Italy

Aerodynamics for MDO of an Innovative Configuration

Bernardini, G., Pisa Univ., Italy; Frediana, A., Pisa Univ., Italy; Morino, L., Rome Univ., Italy; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 16-1 - 16-11; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

A numerical methodology for the evaluation of aero-dynamic loads acting on a complex lifting configuration is presented. The work is limited to the case of attached high-Reynolds number flows. A viscous/potential interaction technique is utilized to take into account the effects of the viscosity. For the potential-flow analysis, a boundary element formulation is used; for simplicity, only incompressible flows are examined. The theoretical basis of the present methodology is briefly described. Comparisons with available, numerical and experimental results are included.
Author

Aerodynamic Loads; Numerical Analysis; Evaluation; Loads (Forces)

20000061443 Synaps Ingenieur-Gesellschaft m.b.H., Bremen, Germany

A Conceptual Design Methodology to Predict the Wave Drag of a Transonic Wing

Kribler, T., Synaps Ingenieur-Gesellschaft m.b.H., Germany; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 27-1 - 27-8; In English; See also 20000061419; Copyright Waived; Avail: CASI; A02, Hardcopy

A conceptual design methodology to predict the wave drag of a transonic wing for use within multidisciplinary aircraft design was developed. to achieve this, a database of cross section designs optimized with respect to total drag was set up varying the design parameters Ma, t/c, C(sub L) and Re. Mathematical formulations for the aerodynamic cross section characteristics total drag, viscous drag and the local shock location were derived from the database as functions of the design parameters. The cross section wave drag was then derived using these formulations. A locally infinite swept wing is assumed and simple sweep theory using the shock sweep angle is used to transform the wave drag. The wave drag of a 3-D wing is predicted summing locally infinite swept wing sections in spanwise direction. The achieved drag prediction is accurate enough for use within conceptual aircraft design and predicts well the trends in wave drag development as a function of the design parameters Ma, t/c, C(sub L), Re and the wing planform.
Author

Aircraft Design; Design Analysis; Wave Drag; Transonic Flow; Wing Planforms

20000061444 Florida Univ., Dept. of Aerospace Engineering, Mechanics and Engineering Science, Gainesville, FL USA

Airfoil and Wing Planform Optimization for Micro Air Vehicles

Sloan, J. G., Florida Univ., USA; Shyy, W., Florida Univ., USA; Haftka, R. T., Florida Univ., USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 28-1 - 28-14; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

Low Reynolds number flight for micro air vehicles (microAVs) suffers from laminar separation resulting in reduced lift and increased drag. The objective of the present work is to use the response surface methodology (RSM) to identify correlations between the airfoil and the wing planform to facilitate a two-level optimization procedure in which an optimized airfoil and wing planform are reached simultaneously. Several approaches have been considered in this work. A constant cross-section wing is modeled with maximum camber, y(sub c), maximum thickness, y(sub t) and aspect ratio,AR, as design variables at two different Reynolds numbers of 8.0 x 10(exp 4) and 2.0 x 10(exp 5). This is done to determine how the optimal airfoil may change for different aspect ratios and Reynolds numbers. A variable cross-section wing defined by root camber and angle-of-attack and tip camber and angle-of-attack is modeled in order to determine how the optimal airfoil may change from the root to the tip of the wing. Due to the size restrictions on microAVs, a fixed-span approach is used to model an aircraft subject to the constraints of

steady flight with the aspect ratio and camber as design variables. This third approach balances trade-offs between wing area, aspect ratio, and Reynolds number in determining the overall flight efficiency. Optimal airfoils exhibit characteristics which change little with wing aspect ratio or location on the wing planform. There appears to be a trend of increasing optimal camber with decreasing Reynolds number. While the optimal design seems to favor airfoils with minimum thickness and relatively modest camber of about 4 to 5% of the chord, a higher camber may be a better choice if higher lift coefficient at minimum power is used as a design goal. Measurements of both the global and the local response surface prediction accuracy combined with design space refinement help to assess the reliability of the response surface approximations and optimal design predictions.
Author
Airfoils; Wing Planforms; Optimization; Camber; Design Analysis; Low Reynolds Number

20000061446 Aerospatiale, Matra Missiles, Chatillon, France
Multi-Flight Condition Optimization of Three Dimensional Supersonic Inlets
Carrier, Gerald, Aerospatiale, France; Bourdeau, Christophe, Aerospatiale, France; Knight, Doyle, Rutgers Univ., USA; Kergaravat, Yan, Aerospatiale, France; Montazel, Xavier, Aerospatiale, France; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 30-1 - 30-10; In English; See also 20000061419
Contract(s)/Grant(s): DDM980001N; Copyright Waived; Avail: CASI; A02, Hardcopy

This paper presents an innovative methodology to address the three-dimensional supersonic inlet design problem. An efficient and robust process allows to optimize the aerodynamic performance of inlets for multiple flight conditions. This optimization process links together an optimizer with a fast and accurate simulation tool into an automated optimization loop. The implementation of this new design technique and its applications to two different test cases are presented, namely, the optimization for a single cruise condition, and the optimization for a mission comprised of acceleration, cruise and maneuver phases. The mission-optimized inlet achieves better overall performance than the cruise-optimized inlet.
Author
Flight Conditions; Supersonic Inlets; Procedures; Three Dimensional Models

20000062458 NASA Glenn Research Center, Cleveland, OH USA
Aeroacoustics Computation for Nearly Fully Expanded Supersonic Jets Using the CE/SE Method
Loh, Ching Y., Taitech, Inc., USA; Hultgren, Lennart S., NASA Glenn Research Center, USA; Wang, Xiao Y., Taitech, Inc., USA; Chang, Sin–Chung, NASA Glenn Research Center, USA; Jorgenson, Philip C. E., NASA Glenn Research Center, USA; June 2000; 16p; In English; 6th; Aeroacoustics, 12-14 Jun. 2000, Maui, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS3-97186; RTOP 523-90-43
Report No.(s): NASA/TM-2000-210225; E-12345; NAS 1.15:210225; AIAA Paper 2000-2010; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper, the space-time conservation element solution element (CE/SE) method is tested in the classical axisymmetric jet instability problem, rendering good agreement with the linear theory. The CE/SE method is then applied to numerical simulations of several nearly fully expanded axisymmetric jet flows and their noise fields and qualitative agreement with available experimental and theoretical results is demonstrated.
Author
Aeroacoustics; Computation; Gas Jets; Supersonic Flow

20000063378 NASA Glenn Research Center, Cleveland, OH USA
Generalized Wall Function for Complex Turbulent Flows
Shih, Tsan–Hsing, NASA Glenn Research Center, USA; Povinelli, Louis A., NASA Glenn Research Center, USA; Liu, Nan–Suey, NASA Glenn Research Center, USA; Chen, Kuo–Huey, Toledo Univ., USA; June 2000; 14p; In English; 38th; Aerospace Sciences, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 522-31-23
Report No.(s): NASA/TM-2000-209936; E-12182; NAS 1.15:209936; ICOMP-2000-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A generalized wall function was proposed by Shih et al., (1999). It accounts the effect of pressure gradients on the flow near the wall. Theory shows that the effect of pressure gradients on the flow in the inertial sublayer is very significant and the standard wall function should be replaced by a generalized wall function. Since the theory is also valid for boundary layer flows toward separation, the generalized wall function may be applied to complex turbulent flows with acceleration, deceleration, separation and recirculation. This paper is to verify the generalized wall function with numerical simulations for boundary layer flows with

various adverse and favorable pressure gradients, including flows about to separate. Furthermore, a general procedure of implementation of the generalized wall function for National Combustion Code (NCC) is described, it can be applied to both structured and unstructured CFD codes.
Author
Computational Fluid Dynamics; Turbulent Flow; Pressure Effects; Walls

20000063489 NASA Langley Research Center, Hampton, VA USA
X-38 Experimental Aerothermodynamics
Horvath, Thomas J., NASA Langley Research Center, USA; Berry, Scott A., NASA Langley Research Center, USA; Merski, N. Ronald, NASA Langley Research Center, USA; Fitzgerald, Steve M., NASA Johnson Space Center, USA; [2000]; 30p; In English; 34th; 34th Thermophysics Conference, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2000-2685; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The X-38 program seeks to demonstrate an autonomously returned orbital test flight vehicle to support the development of an operational Crew Return Vehicle for the International Space Station. The test flight, anticipated in 2002, is intended to demonstrate the entire mission profile of returning Space Station crew members safely back to earth in the event of medical or mechanical emergency. Integral to the formulation of the X-38 flight data book and the design of the thermal protection system, the aerothermodynamic environment is being defined through a synergistic combination of ground based testing and computational fluid dynamics. This report provides an overview of the hypersonic aerothermodynamic wind tunnel program conducted at the NASA Langley Research Center in support of the X-38 development. Global and discrete surface heat transfer force and moment, surface streamline patterns, and shock shapes were measured on scaled models of the proposed X-38 configuration in different test gases at Mach 6, 10 and 20. The test parametrics include angle of attack from 0 to 50 degs, unit Reynolds numbers from 0.3 x 10 (exp 6) to 16 x 10 (exp 6)/ ft, rudder deflections of 0, 2, and 5 deg. and body flap deflections from 0 to 30 deg. Results from hypersonic aerodynamic screening studies that were conducted as the configuration evolved to the present shape at, presented. Heavy gas simulation tests have indicated that the primary real gas effects on X-38 aerodynamics at trim conditions are expected to favorably influence flap effectiveness. Comparisons of the experimental heating and force and moment data to prediction and the current aerodynamic data book are highlighted. The effects of discrete roughness elements on boundary layer transition were investigated at Mach 6 and the development of a transition correlation for the X-38 vehicle is described. Extrapolation of ground based heating measurements to flight radiation equilibrium wall temperatures at Mach 6 and 10 were made and generally compared to within 50 deg F of flight prediction.
Author
Aerothermodynamics; International Space Station; X-38 Crew Return Vehicle; Flight Tests; Computational Fluid Dynamics; Hypersonic Wind Tunnels; Wind Tunnel Tests

20000064077 NASA Ames Research Center, Moffett Field, CA USA
Comment on 'Guidance for an Aerocapture Maneuver
Tauber, Michael E., NASA Ames Research Center, USA; Journal of Guidance, Control, and Dynamics; July - August 1994; Volume 17, No. 4, pp. 878-878; In English; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Copyright; Avail: Issuing Activity; Abstract Only

It is stated that the aerodynamic forces on the vehicle being aerocaptured are controlled by "altering the angle of attack" and thereby controlling the lift coefficient. Furthermore, the resulting variation of drag coefficient with angle of attack was ignored. The purpose of this Comment is to point out that an aerodynamic control method that is much more effective than the pitch modulation has been studied and utilized during entries for many years. During aerocapture, it is desirable to have a large range of lift coefficients available, while keeping the vehicle's ballistic coefficients constant. This is accomplished by modulating the vehicle's bank angle, i.e., by rolling the vehicle about its velocity vector. by this method, the angle of attack can be held constant (at the trim angle, if desired), and the C(sub D) and the ballistic coefficient remain constant. Furthermore, the vertical component of the normal force vector (essentially the lift) can be varied over its entire range, from maximum positive to maximum negative values. Reaction controls, rather than aerodynamic ones, are usually utilized to change the bank angle of the vehicle, thus requiring the use of fuel. However, the fuel expenditure that is required to change the bank angle is far less than the amount that would have to be used to continuously hold the vehicle at pitch angles that differ significantly from its trim angle of attack. Also, it has been shown that bank angle modulation to vary the lift can enlarge the entry corridor by increasing the entry angle for the undershoot boundary, where both the heating rate and deceleration reach a maximum. Finally, the crew's deceleration tolerance can be increased somewhat when the bank angle is varied, as opposed to the pitch angle. For bank modulation, the deceleration force vector can be kept at a constant angle with respect to the occupants whose tolerance to g loads is highest when the force is applied

in a direction normal to the upper torso. The advantages of bank angle variation to modulate the lift vector were recognized long ago, and this method of control was used successfully on the Apollo command module during lunar return' and, more recently, for the Space Shuttle Orbiter.
Author
Aerocapture; Aerodynamic Forces; Angle of Attack; Control Surfaces; Pitch (Inclination)

20000064088 Technische Hogeschool Twente, Faculty of Applied Mathematics, Enschede, Netherlands
Performance of an Implicit Algorithm for Inviscid Flow Around an Airfoil
Strating, P.; vanBuuren, R.; Jun. 25, 1997; 22p; In English
Report No.(s): PB2000-104904; No Copyright; Avail: National Technical Information Service (NTIS)

The authors discuss the parallelization of an implicit solver for the 2d Euler equations on a structured grid. The spatial distribution involves the MUSCL scheme, a Total Variation Diminishing scheme. It is shown that an implicit solver that is based on quasi-Newton iteration and approximate factorization to solve the linear system of equations resulting from the Euler Backward scheme, has favorable properties for both multigrid acceleration and parallelization as compared to explicit Runge-Kutta time stepping. to preserve data locality, the authors apply domain decomposition to obtain a parallelizable code. Although the domain decomposition does affect the efficiency of the approximately factorization method, the results show that this hardly affects the convergence rate as obtained with a single block code. the accuracy with which the linear system of equations is solved is found to be an important parameter. The combination of parallel execution and implicit time integration provides an interesting perspective for time dependent problems in computational fluid dynamics.
NTIS
Algorithms; Inviscid Flow; Computational Fluid Dynamics

20000064608 NASA Ames Research Center, Moffett Field, CA USA
NASA's Aero-Space Technology
Milstead, Phil, NASA Ames Research Center, USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

This presentation reviews the three pillars and the associated goals of NASA's Aero-Space Technology Enterprise. The three pillars for success are: (1) Global Civil Aviation, (2) Revolutionary Technology Leaps, (3) Advanced Space Transportation. The associated goals of the first pillar are to reduce accidents, emissions, and cost, and to increase the aviation system capacity. The goals of the second pillar are to reduce transoceanic travel time, revolutionize general aviation aircraft, and improve development capacity. The goals associated with the third pillar are to reduce the launch cost for low earth orbit and to reduce travel time for planetary missions. In order to meet these goals NASA must provide next-generation design capability for new and or experimental craft which enable a balance between reducing components of the design cycle by up to 50% and or increasing the confidence in design by 50%. These next-generation design tools, concepts, and processes will revolutionize vehicle development. The presentation finally reviews the importance of modeling and simulation in achieving the goals.
CASI
Simulation; Models; NASA Programs; Space Programs; Technology Utilization

20000064627 Boeing Co., Phantom Works, Long Beach, CA USA
Viscous Design Optimization Using ADJIFOR - An HPCCP Perspective
Sundaram, P., Boeing Co., USA; Agrawal, Shreekant, Boeing Co., USA; Hager, James O., Boeing Co., USA; Carle, Alan, Rice Univ., USA; Fagan, Mike, Rice Univ., USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The accurate computation of objective function sensitivity to design variable (DV) perturbations is the most crucial and expensive element of gradient-based optimization. In a nonlinear aerodynamic optimization problem, where the objective functions are computed based on Euler/Navier-Stokes codes, the computation of sensitivities becomes a computational challenge even for today's large parallel systems. The situation gets even worse in constrained aerodynamic shape optimizations where the number of DVs tend to be rather large. The finite-difference method of calculating gradients for these problems is ruled out for two reasons: prohibitive cost and approximation error. Adjoint methods are essential for calculating the gradients. Primary among the adjoint methods is the method of deriving the adjoints by posing the original continuous form of the problem as a calculus of variations problem. This method requires long and tedious analytical derivations and hand-differentiation of the underlying partial differential equations. Furthermore, turbulence models present in Navier-Stokes equation solvers complicate the construction of adjoint codes. Consequently, few commercial Navier-Stokes adjoint codes are available, and those that are available cannot be easily adapted for use in the desired design environment. Automatic differentiation (AD) using ADIFOR has

been known for sometime to be an accurate method of calculating analytical sensitivities of a FORTRAN function code. The forward-mode ADIFOR and adjoint-mode ADJIFOR tools (both components of the soon to be released ADIFOR 3.0 System) automatically enhance function codes with code to compute the required derivatives. In the past year, sensitivity calculations performed by ADIFOR and ADJIFOR-differentiated codes have shown great promise. In last year's HPCCP/CAS workshop, we presented initial results using an ADJIFOR-differentiated version of the CFL3D/Euler code on a shape design optimization problem. The present paper provides further details on the use of the derivative-enhanced CFL3D code as the basis of an automated design environment. In addition, the paper presents a successful HSCT configuration design discovered using this environment on the NAS Origin 2000 parallel system. This success on the CFL3D/Euler code has led to the application of ADJIFOR to compute flow sensitivities for the CFL3D/Navier-Stokes code. The paper compares gradient accuracy and time requirements for computing Navier-Stokes flow sensitivities using both ADIFOR and ADJIFOR-differentiated codes and describes additional steps taken to improve the efficiency of the generated derivative code. Finally, the paper describes the trials and tribulations of adapting ADJIFOR-processed CFL3D viscous gradients for the aerodynamic shape optimization-based design environment to the NAS Origin 2000 and applying it to HSCT configuration design problem.
Author
Applications Programs (Computers); Computational Fluid Dynamics; Design Analysis; Navier-Stokes Equation; Optimization; Computer Systems Design; Computerized Simulation; Mathematical Models

20000064715 Mississippi State Univ., Dept. of Aerospace Engineering, Mississippi State, MS USA
Aero-Structural Interaction, Analysis, and Shape Sensitivity, *1 Jan. - 31 Dec. 1999*
Newman, James C., III, Mississippi State Univ., USA; [1999]; 11p; In English
Contract(s)/Grant(s): NCC1-286
Report No.(s): AIAA Paper 99-3101; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A multidisciplinary sensitivity analysis technique that has been shown to be independent of step-size selection is examined further. The accuracy of this step-size independent technique, which uses complex variables for determining sensitivity derivatives, has been previously established. The primary focus of this work is to validate the aero-structural analysis procedure currently being used. This validation consists of comparing computed and experimental data obtained for an Aeroelastic Research Wing (ARW-2). Since the aero-structural analysis procedure has the complex variable modifications already included into the software, sensitivity derivatives can automatically be computed. Other than for design purposes, sensitivity derivatives can be used for predicting the solution at nearby conditions. The use of sensitivity derivatives for predicting the aero-structural characteristics of this configuration is demonstrated.
Author
Aeroelasticity; Structural Analysis; Sensitivity; Structural Design; Design Analysis; Shapes

20000067656 NASA Langley Research Center, Hampton, VA USA
Exploratory Investigation of Aerodynamic Characteristics of Helicopter Tail Boom Cross-Section Models with Passive Venting
Banks, Daniel W., NASA Dryden Flight Research Center, USA; Kelley, Henry L., Army Aviation and Missile Command, USA; June 2000; 52p; In English
Contract(s)/Grant(s): RTOP 10-11-01
Report No.(s): NASA/TP-2000-210083; NAS 1.60:210083; AMCOM-AFDD/TR-00-A-007; L-17770; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Two large-scale, two-dimensional helicopter tail boom models were used to determine the effects of passive venting on boom down loads and side forces in hovering crosswind conditions. The models were oval shaped and trapezoidal shaped. Completely porous and solid configurations, partial venting in various symmetric and asymmetric configurations, and strakes were tested. Calculations were made to evaluate the trends of venting and strakes on power required when applied to a UH-60 class helicopter. Compared with the UH-60 baseline, passive venting reduced side force but increased down load at flow conditions representing right sideward flight. Selective asymmetric venting resulted in side force benefits close to the fully porous case. Calculated trends on the effects of venting on power required indicated that the high asymmetric oval configuration was the most effective venting configuration for side force reduction, and the high asymmetric with a single strake was the most effective for overall power reduction. Also, curves of side force versus flow angle were noticeable smoother for the vented configurations compared with the solid baseline configuration; this indicated a potential for smoother flight in low-speed crosswind conditions.
Author
Aerodynamic Characteristics; Helicopters; Strakes; Aerodynamic Configurations; Two Dimensional Models; Tail Assemblies

20000068996 NASA Langley Research Center, Hampton, VA USA

Hyper-X Engine Testing in the NASA Langley 8-Foot High Temperature Tunnel

Huebner, Lawrence D., NASA Langley Research Center, USA; Rock, Kenneth E., NASA Langley Research Center, USA; Witte, David W., NASA Langley Research Center, USA; Ruf, Edward G., NASA Langley Research Center, USA; Andrews, Earl H., Jr., FDC/NYMA, Inc., USA; [2000]; 16p; In English; 36th; 36th Joint Propulsion Conference, 17-19 Jul. 2000, Huntsville, AL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-3605; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Airframe-integrated scramjet engine tests have 8 completed at Mach 7 in the NASA Langley 8-Foot High Temperature Tunnel under the Hyper-X program. These tests provided critical engine data as well as design and database verification for the Mach 7 flight tests of the Hyper-X research vehicle (X-43), which will provide the first-ever airframe- integrated scramjet flight data. The first model tested was the Hyper-X Engine Model (HXEM), and the second was the Hyper-X Flight Engine (HXFE). The HXEM, a partial-width, full-height engine that is mounted on an airframe structure to simulate the forebody features of the X-43, was tested to provide data linking flowpath development databases to the complete airframe-integrated three-dimensional flight configuration and to isolate effects of ground testing conditions and techniques. The HXFE, an exact geometric representation of the X-43 scramjet engine mounted on an airframe structure that duplicates the entire three-dimensional propulsion flowpath from the vehicle leading edge to the vehicle base, was tested to verify the complete design as it will be flight tested. This paper presents an overview of these two tests, their importance to the Hyper-X program, and the significance of their contribution to scramjet database development.

Author

Wind Tunnel Tests; Airframes; Data Bases; Engine Airframe Integration; Ground Tests; High Temperature

20000069845 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA

Low-Speed Wind Tunnel Tests on a Diamond Wing High Lift Configuration

Ghee, Terence A.; Taylor, Nigel J.; Jun. 2000; 5p; In English

Report No.(s): AD-A377908; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

On modem military air vehicles, high lift systems are used to improve takeoff and landing performance. For naval air vehicles, an improvement in the lift coefficient of a landing or approach configuration allows for arrested landings at reduced speeds or the ability to carry more weight back to the ship. For conventional takeoff or landing (CTOL), improved lift to drag ratios allow for shorter takeoff runs or greater payload capacity.

DTIC

Wind Tunnel Tests; Low Aspect Ratio Wings; Aircraft Performance; Aerodynamic Configurations

20000070491 NASA Langley Research Center, Hampton, VA USA

Prediction of Transonic Vortex Flows Using Linear and Nonlinear Turbulent Eddy Viscosity Models

Bartels, Robert E., NASA Langley Research Center, USA; Gatski, Thomas B., NASA Langley Research Center, USA; May 2000; 35p; In English

Contract(s)/Grant(s): RTOP 522-31-21-05

Report No.(s): NASA/TM-2000-210282; L-17986; NAS 1.15:210282; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Three-dimensional transonic flow over a delta wing is investigated with a focus on the effect of transition and influence of turbulence stress anisotropies. The performance of linear eddy viscosity models and an explicit algebraic stress model is assessed at the start of vortex flow, and the results compared with experimental data. to assess the effect of transition location, computations that either fix transition or are fully turbulent are performed. To assess the effect of the turbulent stress anisotropy, comparisons are made between predictions from the algebraic stress model and the linear eddy viscosity models. Both transition location and turbulent stress anisotropy significantly affect the 3D flow field. The most significant effect is found to be the modeling of transition location. At a Mach number of 0.90, the computed solution changes character from steady to unsteady depending on transition onset. Accounting for the anisotropies in the turbulent stresses also considerably impacts the flow, most notably in the outboard region of flow separation.

Author

Transonic Flow; Vortices; Nonlinearity; Eddy Viscosity; Three Dimensional Flow; Mathematical Models

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation.

20000058179 Cherry (R. G. W.) and Associates Ltd., Hertford, UK
Benefit Analysis for Aircraft 16-g Dynamic Seats *Final Report*
Cherry, R.; Warren, K.; Chan, A.; Apr. 2000; 248p; In English
Report No.(s): PB2000-105406; DOT/FAA/AR-00/13; No Copyright; Avail: CASI; A03, Microfiche; A11, Hardcopy

The objective of this study was to assess the number of serious injuries and fatalities that might have been avoided by the use of 16-g dynamic seats during the period of 1984 to 1998 for survivable accident involving transport category aircraft operating under 14 CFR Part 121. Twenty-five impact- related accidents involving aircraft operating to 14 CFR Part 121, or equivalent, were identified during the period from 1984 to 1998 that may have had seat-related fatal or serious injuries. Each of these accidents was analyzed in detail and a mathematical technique was used to model each accident scenario. Monte Carlo simulations were used to assess a high, median, and low value for the total achievable benefits over the period 1984 to 1998 to US registered aircraft operating under 14 CFR Part 121. Two methodologies were used. The first was based on worldwide accident data for aircraft operating under 14 CFR Part 121 or equivalent. The second analysis was carried out on the accident data pertaining to US aircraft operating under CFR Part 121 only.
NTIS
Seats; Crashworthiness; Cost Analysis; Cost Effectiveness

20000062019 NASA Langley Research Center, Hampton, VA USA
Comparison of Pilots' Situational Awareness While Monitoring Autoland Approaches Using Conventional and Advanced Flight Display Formats
Kramer, Lynda J., NASA Langley Research Center, USA; Busquets, Anthony M., NASA Langley Research Center, USA; May 2000; 125p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 522-19-11-01
Report No.(s): NASA/TP-2000-210284; NAS 1.60:210284; L-17981; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A simulation experiment was performed to assess situation awareness (SA) and workload of pilots while monitoring simulated autoland operations in Instrument Meteorological Conditions with three advanced display concepts: two enhanced electronic flight information system (EFIS)-type display concepts and one totally synthetic, integrated pictorial display concept. Each concept incorporated sensor-derived wireframe runway and iconic depictions of sensor-detected traffic in different locations on the display media. Various scenarios, involving conflicting traffic situation assessments, main display failures, and navigation/autopilot system errors, were used to assess the pilots' SA and workload during autoland approaches with the display concepts. From the results, for each scenario, the integrated pictorial display concept provided the pilots with statistically equivalent or substantially improved SA over the other display concepts. In addition to increased SA, subjective rankings indicated that the pictorial concept offered reductions in overall pilot workload (in both mean ranking and spread) over the two enhanced EFIS-type display concepts. Out of the display concepts flown, the pilots ranked the pictorial concept as the display that was easiest to use to maintain situational awareness, to monitor an autoland approach, to interpret information from the runway and obstacle detecting sensor systems, and to make the decision to go around.
Author
Flight Simulation; Automatic Pilots; Display Devices; Workloads (Psychophysiology); Navigation Aids; Control Simulation; Guidance Sensors; Head-Up Displays

20000062844 National Transportation Safety Board, Washington, DC USA
Aircraft Accident Report: Controlled Flight into Terrain Korean Air Flight 801, Boeing 747-300, HL7468, Nimitz Hill, Guam, August 6, 1997
Jan. 13, 2000; 222p; In English
Report No.(s): AD-A377407; NTSB/AAR-00/01; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

On August 6, 1997, about 0142:26 Guam local time, Korean Air flight 801, a Boeing 747-3B5B (747-300), Korean registration 11L7468, operated by Korean Air Company, Ltd., crashed at Nimitz Hill, Guam. Flight 801 departed from Kimpo International Airport, Seoul, Korea, with 2 pilots, 1 flight engineer, 14 flight attendants, and 237 passengers on board. The airplane

had been cleared to land on runway 6 Left at A.B. Won Guam International Airport, Agana, Guam, and crashed into high terrain about 3 miles southwest of the airport. of the 254 persons on board, 228 were killed, and 23 passengers and 3 flight attendants survived the accident with serious injuries. The airplane was destroyed by impact forces and a postcrash fire. Flight 801 was operating in U.S. airspace as a regularly scheduled international passenger service flight under the Convention on International Civil Aviation and the provisions of 14 Code of Federal Regulations Part 129 and was on an instrument flight rules flight plan. The National Transportation Safety Board determines that the probable cause of the Korean Air flight 801 accident was the captain's failure to adequately brief and execute the nonprecision approach and the first officer's and flight engineer's failure to effectively monitor and cross-check the captain's execution of the approach. Contributing to these failures were the captain's fatigue and Korean Air's inadequate flight crew training. Contributing to the accident was the Federal Aviation Administration's (FAA) intentional inhibition of the minimum safe altitude warning system (MSAW) at Guam and the agency's failure to adequately manage the system. The safety issues in this report focus on flight crew performance, approach procedures, and pilot training; air traffic control, including controller performance and the intentional inhibition of the MSAW system at Guam; emergency response; the adequacy of Korean Civil Aviation Bureau (KCAB) and FAA over
DTIC
Aircraft Accidents; Pilot Error; Human Performance; Flight Crews; Education; Pilot Training

20000063509 NASA Glenn Research Center, Cleveland, OH USA
Freezing Rain as an In-Flight Icing Hazard
Bernstein, Ben C., National Center for Atmospheric Research, USA; Ratvasky, Thomas P., NASA Glenn Research Center, USA; Miller, Dean R., NASA Glenn Research Center, USA; McDonough, Frank, National Center for Atmospheric Research, USA; June 2000; 12p; In English; 8th; Aviation, Range and Aerospace Meteorology, 10-15 Jan. 1999, Dallas, TX, USA; Sponsored by American Meteorological Society, USA
Contract(s)/Grant(s): NAS3-88; RTOP 548-21-23
Report No.(s): NASA/TM-2000-210058; E-12260; NAS 1.15:210058; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Exposure to supercooled large drops (SLD-subfreezing water droplets with diameters greater than approx. 50 microns) can pose a significant threat to the safety of some aircraft. Although SLD includes both freezing drizzle (FZDZ) and freezing rain (FZRA), much of the SLD research and development of operational SLD forecast tools has focused on FZDZ and ignored FZRA, regarding is as less of a hazard to aviation. This paper provides a counterpoint case study that demonstrates FZRA as a significant in-flight icing hazard. The case study is based on flight and meteorological data from a joint NASA/FAA/NCAR SLD icing research project collected on February 4, 1998. The NASA Twin Otter Icing Research Aircraft experienced a prolonged exposure to "classical" FZRA that formed extensive ice formations including ridges and nodules on the wing and tail, and resulted in a substantial performance penalty. Although the case study provides only a singular FZRA event with one aircraft type, it is clear that classical FZRA can pose a significant in-flight icing hazard, and should not be ignored when considering SLD issues.
Author
Freezing; Ice Formation; Drop Size; Forecasting; Meteorological Parameters; Rain

20000065634 Instituto Nacional de Tecnica Aeroespacial, Torrejon de Ardoz, Spain
Development of an Ice Accretion Prediction Code: Calculation of Efficiency Collection Module ***Desarrollo de un Codigo de Simulacion de Hielo: Modelo de Calculo de la Eficiencia de Captacion***
Duran, Jose Antonio Aparicio, Instituto Nacional de Tecnica Aeroespacial, Spain; March 2000; 50p; In Spanish
Report No.(s): TNO/4410/003/INTA/00; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This is part of a research project to develop a 2D ice accretion prediction code, called CODICE. This report focuses upon the subroutines which calculate the ice droplet trajectory and efficiency collection, in simple and multicomponent (profile with flap) airfoils, combined into a code called ICETRAJECT. This code can be used both with structured and unstructured grids. With regard to unstructured grids it has been developed a new interpolation method based on QUADTREE generation and linked lists data structure. This method improves the interpolation process in this kind of meshes to get velocity field flow, needed to calculate droplet trajectories. The velocity field flow, which is the input of ICETRAJECT can be computated by any external structured and unstructured solver.
Author
Ice Formation; Prediction Analysis Techniques; Applications Programs (Computers); Drops (Liquids); Trajectories

20000065678 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Examining Air Mobility Command Support to the Expeditionary Aerospace Force
Gimbus, Martin T.; Jun. 1999; 57p; In English
Report No.(s): AD-A372348; AFIT/GMO/LAL/99Y-5; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Air Force has been tasked at an ever-increasing rate to support contingency operations around the world. These operations range from providing relief supplies to hurricane victims to providing combat firepower to enforce no-fly zones in Southwest Asia. As the Air Force responds to these contingencies, its opstempo has risen dramatically. The family lives of Air Force people are disrupted by the frequent and unpredictable deployments, which pushes experienced people out of the service. to counter these almost daily crises, the Air Force is creating a new organizational structure, the Expeditionary Aerospace Forces. The structure is based on providing light, lean forces, tailored to each individual contingency that allows rapid and decisive response to any potential crisis. This concept allows stability by providing a 15-month fixed schedule of what units would deploy and when. This paper examines the support required by Air Mobility Command's airlift and air refueling assets under the Expeditionary concept. It focuses on the expected workload in deployment days for crews. The research compares current opstempo with the opstempo associated with past Air Expeditionary Force-type deployments and expected workload from the new concept. The results of the research depict a slight increase in opstempo under the Expeditionary concept but also discusses other possible reasons for the increase.
DTIC
Mobility; Support Systems; Aerospace Systems

20000066577 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Reducing Aircraft Quick-Turn Ground Times in the European Environment
Carlson, Karn L.; Jan. 1999; 47p; In English
Report No.(s): AD-A372327; AFIT/GMO/LAL/99Y-2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Air Force has a limited number of air mobility aircraft and aircrews and these resources are becoming increasingly strained. Added to this, our workload is increasing - we are involved in an ever-increasing number of operations and exercises. Instead of working harder we need to work smarter, by looking for ways to process our aircraft more quickly and efficiently, yet maintain the needed safety standards.
DTIC
Flight Crews; Mobility

20000068449 Futron Corp., Bethesda, MD USA
Report on the Effects of Parachutes on Risk Mitigation to Third-party Property and Individuals
Mears, A. K., Futron Corp., USA; Mar. 1993; 10p; In English
Report No.(s): PB2000-105824; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

A study on the public's exposure to risk caused by an object or payload landing upon its arrival from an orbital or suborbital flight trajectory. An investigation was conducted looking for research that may have been done or information that may have been gathered that is able to qualitatively or quantitatively discuss the magnitude of risk, or differential (delta) due to the presence of a parachute, to people or property on the ground in comparison to the risks of an object descending in free fall; essentially ballistically. The basic question the study seeks to answer is: 'Why is it safe to release an object on a parachute while it is unsafe to release it without a parachute.'
NTIS
Flight Paths; Parachutes; Payloads; Suborbital Flight; Risk; Parachute Descent

20000070325 General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
Essential Air Service Changes in Passenger Traffic, Subsidy Levels, and Air Carrier Costs
Anderson, John H., Jr; May 25, 2000; 16p; In English; Testimony: Before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, House of Representatives
Report No.(s): AD-A377720; GAO/T-RCED-00-185; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Over two decades have passed since the Congress phased out the federal government's control over airfares and service. Concerned that air service to some small communities would suffer in a deregulated environment, the Congress established the Essential Air Service (EAS) program as part of the Airline Deregulation Act of 1978 and made special provisions for providing this service in Alaska. The objective of the EAS program, administered by the Department of Transportation (DOT), is to ensure that small communities that had received scheduled passenger air service before deregulation continued to have access to the nation's air transportation system. DOT does this by awarding subsidies to carriers willing to provide service to communities that

would not otherwise receive it. Recently, we issued a report on changes in the subsidy levels and costs for the EAS program in 1999 compared with 1995. Our testimony today, which is based on information developed for that report, focuses on three major topics: (1) changes in the number of communities and passengers receiving subsidized service, (2) changes in the level of subsidies provided, and (3) reasons why the subsidy levels changed.
DTIC
Governments; Regulations; Rules; Costs; Cost Analysis

20000070352 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Department of the Navy NITE Lab Training
Antonio, Joseph; Oct. 08, 1999; 6p; In English
Report No.(s): AD-A376038; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The purpose of this briefing is to provide an update on night vision goggle training conducted in the Marine Corps and Navy Night Imaging and Threat Evaluation (NITE) Lab training facilities, and to describe changes in the mechanism in which courseware and instruction is standardized. The NITE Lab concept has continued to evolve since its development in the mid-1980s. Today, it is thoroughly integrated with simulator and flight training, all combined to provide aircrew with as much information and practical experience as possible before the first tactical sortie. Additionally, the designation of a model manager position will help insure that quality instruction is provided to all aircrew and that funding will be available to support the necessary efforts.
DTIC
Night Vision; Imaging Techniques; Goggles; Training Simulators; Flight Training

20000070422 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne, Australia
Trial of Global Positioning System Based Field Wreckage Plotting and Analysis Equipment Using Data from a USMC F/A-18 Aircraft Accident
Barber, S. A.; Molent, L.; Jun. 1999; 56p; In English
Report No.(s): AD-A368420; DSTO-TR-0828; DODA-AR-010-993; Copyright; Avail: Defense Technical Information Center (DTIC)

On August 20, 1998 a USA Marine Corps F/A-18 aircraft crashed at Delamere bombing range in the Northern Territory. AMRL was invited to aid in the investigation by trialing the AMRL wreckage mapping and analysis equipment at the site. The equipment was used to plot and record all wreckage of interest. Maps of the wreckage were produced on site and handed over to the accident investigation team. These rapidly produced maps, along with the experience brought with the AMRL investigators with on site wreckage examination, greatly aided the accident investigation team to expedite recovery of the site and clarify many aspects of the accident to this end, the trial of the equipment was very successful. Following this trial, the data was used to explore the capabilities of other visualisation software, and its relevance to accident investigation. The results of this are presented during the discussion of the accident.
DTIC
Global Positioning System; Plotting; Wreckage; F-18 Aircraft; Aircraft Accidents

20000070473 Naval Postgraduate School, Monterey, CA USA
Development of An Expert System and Software Agent for Aviation Safety Assessment
Flowers, Thomas R.; Dowler, David M.; Mar. 2000; 158p; In English
Report No.(s): AD-A377634; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The primary goal of this thesis is to design, develop and test an internet based prototype model for using expert system and software agent technologies to automate some of the analytical tasks in conducting aviation safety assessments using the data collected by the automated Aviation Command Safety Assessment (ACSA) system. The Aviation Command Safety Assessment is a questionnaire survey methodology developed to evaluate a Naval Aviation Command's safety climate, culture, and safety program effectiveness. The survey was a manual process first administered in the fall of 1996. The survey was then automated in 1999 and is administered over the World Wide Web. The results of this thesis are a prototype model and a software agent application that evaluates data contained in the ACSA database for organizational safety assessment and for database integrity. All source code is provided and discussed in detail.
DTIC
Aircraft Safety; Flight Safety; Software Engineering; Computer Programs; Expert Systems

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control.

20000061967 Computer Sciences Corp., Lanham, MD USA
Autonomous Relative Navigation for Formation-Flying Satellites Using GPS
Gramling, Cheryl, NASA Goddard Space Flight Center, USA; Carpenter, J. Russell, NASA Goddard Space Flight Center, USA; Long, Anne, Computer Sciences Corp., USA; Kelbel, David, Computer Sciences Corp., USA; Lee, Taesul, Computer Sciences Corp., USA; [2000]; 10p; In English; 15th; Spaceflight Dynamics, Jun. 2000, Biarritz, France
Contract(s)/Grant(s): GS-35F-4381G; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Goddard Space Flight Center is currently developing advanced spacecraft systems to provide autonomous navigation and control of formation flyers. This paper discusses autonomous relative navigation performance for a formation of four eccentric, medium-altitude Earth-orbiting satellites using Global Positioning System (GPS) Standard Positioning Service (SPS) and "GPS-like " intersatellite measurements. The performance of several candidate relative navigation approaches is evaluated. These analyses indicate that an autonomous relative navigation position accuracy of 1meter root-mean-square can be achieved by differencing high-accuracy filtered solutions if only measurements from common GPS space vehicles are used in the independently estimated solutions.
Author
Global Positioning System; Autonomous Navigation; Satellites; Guidance (Motion)

20000063533 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
JPL Global GPS Network
Moore, A. W., Jet Propulsion Lab., California Inst. of Tech., USA; Stowers, D. A., Jet Propulsion Lab., California Inst. of Tech., USA; Khachikyan, R., Jet Propulsion Lab., California Inst. of Tech., USA; Marcin, M. R., Jet Propulsion Lab., California Inst. of Tech., USA; Harris, I. L., Jet Propulsion Lab., California Inst. of Tech., USA; Zumberge, J. F., Jet Propulsion Lab., California Inst. of Tech., USA; [1998]; 10p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The research described in this viewgraph was carried out by the Jet Propulsion Laboratory (JPL), California Institute of Technology, under a contract with the National Aeronautics and Space Administration (NASA). JPL currently operates more than 55 permanent, continuously operating GPS ground stations for NASA many in conjunction with international and regional agencies. The data are automatically uploaded from the remote stations, processed, and distributed, with a high degree of reliability.
Derived from text
Global Positioning System; NASA Programs; Data Processing; Networks

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology.

20000058095 McDonnell-Douglas Corp., Long Beach, CA USA
Supersonic Cruise Point Design Optimization of TCA
Unger, Eric R., McDonnell-Douglas Corp., USA; Narducci, Robert P., McDonnell-Douglas Corp., USA; Hager, James O., McDonnell-Douglas Corp., USA; Kuruvila, Geojoe, McDonnell-Douglas Corp., USA; Hartwich, Peter M., McDonnell-Douglas Corp., USA; Agrawal, Shreekant, McDonnell-Douglas Corp., USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 114-188; In English; See also 20000058091; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Since July of 1996, McDonnell Douglas (along with other teams from NASA Ames and Boeing Commercial Aircraft Group), has been working on a second series of optimizations for the TCA configuration. The approach used at MDC was conservative in terms of acceptable geometric qualities that were allowed to appear in the final Cycle 2 design. The hope was that any final outcome would be more robust and raise the least amount of uncertainties from other technology disciplines. The downside of this approach was the inability to fully maximize the possible L/D gains within the given time and within these strict geometric guidelines. This paper presents an overview of MDC's final Cycle 2 configuration. First, a brief introduction and highlights of

the new design are given along with some geometric details. Second, a look at the configuration's overall performance and pressure field details will be given. Next, some details of the design constraints that were used during optimization will be described. And finally, the paper will close with a summary of the Cycle 2 configuration and a look ahead to the immediate future.
Derived from text
Design Analysis; Optimization; Supersonic Transports; Body-Wing Configurations; Civil Aviation

20000058097 McDonnell-Douglas Corp., Long Beach, CA USA
TCA Nacelle Installation Assessment and Design Studies
Arslan, Alan, McDonnell-Douglas Corp., USA; Sundaram, P., McDonnell-Douglas Corp., USA; Shieh, Chih–Fang, McDonnell-Douglas Corp., USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 255-304; In English; See also 20000058091; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper presents the computational investigation of the PAI (Propulsion/Airframe Integration) related study in which the primary objective is to assess and then reduce the installation drag of the nacelles for the TCA configuration at the supersonic cruise condition of M (sub infinity)= 2.4, C (sub L)= 0.1. As a first step in reducing the nacelle installation drag, it is necessary to assess the baseline installation. This assessment refers to interference and installation drag assessments, as well as flowfield assessment, at both flight (Re (sub c)= 212 million) and wind-tunnel (Re (sub c)= 6.36 million) conditions. An analysis of th inlet flowfield quality is necessary to assess alignment. After satisfying inlet constraints by aligning the inlets with the local flowfield, the drag is reassessed. An assessment of the boundary layer height at the diverter leading edge suggests a height reduction for the inboard diverter. Finally, diverter and nacelle shape modifications were attempted with limited success.
Author
Nacelles; Supersonic Transports; Body-Wing Configurations; Diverters; Wind Tunnel Tests; Engine Airframe Integration; Design Analysis

20000058099 McDonnell-Douglas Corp., Long Beach, CA USA
Uncertainties in HSCT Cruise Drag Prediction
Agrawal, Shreekant, McDonnell-Douglas Corp., USA; Novean, Michael G. B., McDonnell-Douglas Corp., USA; Kuruvila, Geojoe, McDonnell-Douglas Corp., USA; Narducci, Robert P., McDonnell-Douglas Corp., USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 376-440; In English; See also 20000058091; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Within the High Speed Research (HSR) program, NASA and Industry are jointly developing various technologies so that the U.S. Industry has the capability to launch the High Speed Civil Transport (HSCT) aircraft development in early 2000. One of the primary objectives of the HSR program is to be able to predict the cruise aerodynamic performance of the HSCT configurations with a sufficiently high confidence level that will aide industry in the decision to proceed with the development of the aircraft and guarantee its performance to its airline customers. This paper addresses the current status in the prediction of drag at primarily the supersonic cruise Mach number (M = 2.4), however, drag at the transonic cruise Mach number (M = 0.9) is also presented, wherever appropriate. The thrust of this paper is the uncertainty (or the confidence level) in drag prediction. Use is made of the available experimental, linear and nonlinear computational, and empirical database to the McDonnell Douglas Corporation (MDC). In some cases, there is sufficient database; in some other cases, there is very little database; and yet in some other cases, there is none available. However, an attempt is made to see where we stand today in the cruise drag prediction, although it is difficult to determine uncertainty levels in all the elements contributing to drag. Please note that the uncertainty levels discussed here are the views of the researchers at MDC only, and they may not represent those at other organizations.
Derived from text
Aerodynamic Drag; Supersonic Transports; Aerodynamic Characteristics; Civil Aviation; Performance Prediction; Supersonic Speed

20000058101 NASA Langley Research Center, Hampton, VA USA
Forced Transition Techniques on HSCT Configurations
Wahls, Richard A., NASA Langley Research Center, USA; Bauer, Steven X. S., NASA Langley Research Center, USA; Owens, Lewis R., Jr., NASA Langley Research Center, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 477-508; In English; See also 20000058091; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This presentation describes the general objectives of the project, followed by background information which led to the initiation of the study, and the approach taken to meet the objectives. Next, experimental studies in the LaRC Unitary Plan Wind

Tunnel, the NMA Polysonic Wind Tunnel, and the National Transonic Facility will be discussed. Concluding remarks will close the presentation.
Derived from text
Civil Aviation; Supersonic Transports; Transonic Wind Tunnels; Aerodynamic Configurations; Boundary Layer Transition

20000058103 NASA Langley Research Center, Hampton, VA USA
Analysis and Multipoint Design of the TCA Concept
Krist, Steven E., NASA Langley Research Center, USA; Bauer, Steven X. S., NASA Langley Research Center, USA; Buning, Pieter G., NASA Langley Research Center, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 544-560; In English; See also 20000058091; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The goal in this effort is to analyze the baseline TCA concept at transonic and supersonic cruise, then apply the natural flow wing design concept to obtain multipoint performance improvements. Analyses are conducted with OVERFLOW, a Navier-Stokes code for overset grids, using PEGSUS to compute the interpolations between the overset grids.
Derived from text
Aircraft Design; Civil Aviation; Supersonic Speed; Transonic Speed; Multigrid Methods; Body-Wing Configurations

20000058104 NASA Langley Research Center, Hampton, VA USA
TLNS3D/CDISC Multipoint Design of the TCA Concept
Campbell, Richard L., NASA Langley Research Center, USA; Mann, Michael J., NASA Langley Research Center, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 561-587; In English; See also 20000058091; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper presents the work done to date by the authors on developing an efficient approach to multipoint design and applying it to the design of the HSR TCA configuration. While the title indicates that this exploratory study has been performed using the TLNS3DMB flow solver and the CDISC design method, the CDISC method could have been used with any flow solver, and the multipoint design approach does not require the use of CDISC. The goal of the study was to develop a multipoint design method that could achieve a design in about the same time as 10 analysis runs.
Derived from text
Design Analysis; Applications Programs (Computers); Civil Aviation; Multigrid Methods; Aerodynamic Configurations

20000058108 Boeing Commercial Airplane Co., HSCT Aerodynamics, Seattle, WA USA
Development of TCA Flight Drag Polars for Airplane Performance
Nelson, Chester P., Boeing Commercial Airplane Co., USA; Adamson, Eric E., Boeing Commercial Airplane Co., USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 707-727; In English; See also 20000058091; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

In early 1996 the NASA-industry High Speed Research Technical Integration team released the final definition of the HSCT Technology Concept Airplane (TCA). This configuration represents the integration of current inputs from all technical disciplines into a realistic High Speed Civil Transport concept. This paper reviews the development and content of the high speed aerodynamics inputs to the TCA sizing and flight performance predictions. The paper also summarizes subsequent detailed analysis work, CFD, and TCA wind tunnel test data that are now being used to assess the drag levels of the "status" airplane (i.e. without projections). A bottoms-up assessment of the high speed drag technology projection is shown to identify reasonable sources of drag improvements that would meet the target levels. Sources of uncertainty in the current HSCT high speed drag predictions are outlined, and areas for risk reduction in future performance predictions are identified.
Author
Aerodynamic Drag; Civil Aviation; Wind Tunnel Tests; Supersonic Transports; Computational Fluid Dynamics; Helicopter Performance

20000060806 NASA Langley Research Center, Hampton, VA USA
An Integrated Low-Speed Performance and Noise Prediction Methodology for Subsonic Aircraft
Olson, E. D., NASA Langley Research Center, USA; Mavris, D. N., Georgia Inst. of Tech., USA; [2000]; 12p; In English; Aeroacoustics, 12-14 Jun. 2000, Lahaina, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-2070; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

An integrated methodology has been assembled to compute the engine performance, takeoff and landing trajectories, and community noise levels for a subsonic commercial aircraft. Where feasible, physics-based noise analysis methods have been used

to make the results more applicable to newer, revolutionary designs and to allow for a more direct evaluation of new technologies. The methodology is intended to be used with approximation methods and risk analysis techniques to allow for the analysis of a greater number of variable combinations while retaining the advantages of physics-based analysis. Details of the methodology are described and limited results are presented for a representative subsonic commercial aircraft.
Author
Low Speed; Aircraft Performance; Noise Prediction; Aircraft Noise; Noise Pollution; Noise Intensity

20000060848 NASA Langley Research Center, Hampton, VA USA
Separation Control at Flight Reynolds Numbers: Lessons Learned and Future Directions
Seifert, Avi, Tel-Aviv Univ., Ramat-Aviv, Israel; Pack, LaTunia G., NASA Langley Research Center, USA; [2000]; 20p; In English; Fluids, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-2542; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Active separation control, using periodic excitation, was studied experimentally at high Reynolds numbers. The effects of compressibility, mild sweep, location o excitation slot and steady momentum transfer on the efficacy of the method were identified. Tests conducted at chord Reynolds numbers as high as 40 x 10(exp 6) demonstrated that active control using oscillatory flow excitation can effectively delay flow separation from and reattach separated flow to aerodynamic surfaces at flight conditions. The effective frequencies generate one to four vortices over the controlled region at all times, regardless of the Reynolds number. The vortices are initially amplified by the separated shear-layer, and after initiating reattachment, the strength of the vortices decay as they are convected downstream. Large amplitude, low frequency vortices break down to smaller ones upon introduction at the excitation slot. The effects of steady mass transfer were compared to those of periodic excitation. It was found that steady blowing is significantly inferior to periodic excitation in terms o performance benefits and that the response to steady blowing is abrupt, and therefore undesirable from a control point of view. Steady suction and periodic excitation are comparable in effectiveness and both exhibit a gradual response to changes in the magnitude of the control input. The combination of weak steady suction and periodic excitation is extremely effective while the addition of steady blowing could be detrimental. Compressibility effects are weak as long as separation is not caused by a shock-wave/boundary-layer interaction The undesirable effects of the shock-induced separation could be alleviated by the introduction of periodic excitation upstream of the shock wave, inside the region of supersonic flow. The effects of mild sweep were also studied and periodic excitation was found to be very effective in reattaching three-dimensional separated flow. Scaling laws that correlate 2D and 3D controlled flows were tested and verified. Several performance benefits could be gained by applying the method to existing configurations, but it is expected that the full potential of the method can only be realized through the design of new configurations. A comprehensive, fully turbulent, database was generated in order to guide the development, and enable validation, of candidate unsteady CFD design tools.
Author
Active Control; Boundary Layer Separation; Control Surfaces; Data Bases; Ground Based Control; High Reynolds Number; Momentum Transfer; Shock Waves

20000061421 Boeing Phantom Works, Air Vehicle Advanced Design, Long Beach, CA USA
The Future Role of Virtual Design Teams
Guthrie, Charlie, Boeing Phantom Works, USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 2-1 - 2-3; In English; See also 20000061419; Copyright Waived; Avail: CASI; A01, Hardcopy

This keynote presentation will discuss the role that our aerospace engineers and their design teams and tools will play in the "Virtual" design office of the future. Dramatically improving information technology is rapidly changing the design environment and the potential capability of the design toolsets. Along with these improvements in capability, there is a change in our expectations and requirements for both the design teams and the tools that enable the design teams to accomplish their tasks.
Author
Engineers; Information Systems

20000061423 Lockheed Martin Corp., Skunk Works, Palmdale, CA USA
Role of the Aerodynamicist in a Concurrent Multi-Disciplinary Design Process
Nicolai, Leland M., Lockheed Martin Corp., USA; Carty, Atherton, Lockheed Martin Corp., USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 4-1 - 4-14; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

As the affordability of new aircraft and missile systems becomes an essential element of new development programs, the time spent in the early design (conceptual and preliminary design) needs to be reduced. This paper will address the time and activities

associated with the conceptual and preliminary design of an aircraft, the role of the aerodynamicist in this early design period and the tools that he uses. The question of how the design time can be shortened will be discussed and what the aerodynamicist can do about it.
Author
Design Analysis; Time Dependence; Aircraft Design

20000061424 Cranfield Univ., Coll. of Aeronautics, Cranfield, UK
Learning Through Experience: Group Design Projects on the Masters Course in Aircraft Engineering
Jones, R. I., Cranfield Univ., UK; Scott, R. G., British Aerospace, UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 5-1 - 5-11; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

The successful completion of aerospace projects usually involves the bringing together of many different specialist skills. The need for aerospace engineers to be conversant with many disciplines and aware of the many facets of a project is today's reality. However, in today's working environment it is becoming increasingly difficult for individuals to achieve the necessary experience, with the timescales for major aerospace projects getting ever longer and their number decreasing. The Group Design Projects within the Aircraft Engineering course have the specific purpose of addressing this issue. They provide the opportunity for aerospace engineers from a range of disciplines to be involved in a real project, with many of the difficulties and constraints of those they will meet in their working lives. These projects progress through the full design process and provide this experience within a limited time period and, relatively, limited risk environment. In addition to meeting their basic objective, Group Design Projects commenced to-date have proved very demanding but provided further benefits to all concerned.
Author
Flat Surfaces; Design Analysis; Education

20000061425 Pisa Univ., Dept. of Aerospace Engineering, Italy
An Optimisation Procedure for the Conceptual Analysis of Different Aerodynamic Configurations
Lombardi, G., Pisa Univ., Italy; Mengali, G., Pisa Univ., Italy; Beux, F., Scuola Normale Superiore, Italy; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 6-1 - 6-10; In English; See also 20000061419; Copyright Waived; Avail: CASI; A02, Hardcopy

This paper addresses the problem to define a methodology for the analysis of the performances of different aircraft configurations in the phase of conceptual design. The proposed approach is based on a numerical optimisation procedure where a scalar objective function, the take-off weight, is minimized. The optimisation algorithm has obviously important consequences both from the point of view of the computational times and of the obtained results. For this reason a preliminary discussion is made where various different methodologies are critically compared. Although the best compromise between different approaches is probably given by an integration between a genetic algorithm approach and a classical gradient method, in this phase only the latter procedure has been used to pe$orm the simulations. The methodology takes into account the high number of geometrical parameters and the flight mechanics requirements involved in the problem. A basic example is described, and the use of the proposed methodology to investigate the effects of different geometrical and technological parameters is discussed.
Author
Aerodynamic Configurations; Aircraft Configurations; Measure and Integration; Optimization

20000061426 NASA Ames Research Center, Moffett Field, CA USA
Aero-Mechanical Design Methodology for Subsonic Civil Transport High-Lift Systems
vanDam, C. P., California Univ., USA; Shaw, S. G., California Univ., USA; VanderKam, J. C., California Univ., USA; Brodeur, R. R., California Univ., USA; Rudolph, P. K. C., PKCR, Inc., USA; Kinney, D., NASA Ames Research Center, USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 7-1 - 7-12; In English; See also 20000061419
Contract(s)/Grant(s): NCC2-5188; NCC2-5255; SNL-A0273; A46374D(LAS); A49736D(SLS); Copyright Waived; Avail: CASI; A03, Hardcopy

In today's highly competitive and economically driven commercial aviation market, the trend is to make aircraft systems simpler and to shorten their design cycle which reduces recurring, non-recurring and operating costs. One such system is the high-lift system. A methodology has been developed which merges aerodynamic data with kinematic analysis of the trailing-edge flap mechanism with minimum mechanism definition required. This methodology provides quick and accurate aerodynamic performance prediction for a given flap deployment mechanism early on in the high-lift system preliminary design stage. Sample

analysis results for four different deployment mechanisms are presented as well as descriptions of the aerodynamic and mechanism data required for evaluation. Extensions to interactive design capabilities are also discussed.
Author
Procedures; Design Analysis; Subsonic Speed; Operating Costs; Kinematics; Commercial Aircraft; Aerodynamic Characteristics

20000061427 Defence Evaluation Research Agency, Farnborough, UK
Conceptual Design and Optimisation of Modern Combat Aircraft
Crawford, C. A., Defence Evaluation Research Agency, UK; Simm, S. E., Defence Evaluation Research Agency, UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 8-1 - 8-11; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

The design of a combat aircraft is an extremely complex task, due to the large range of design variables available. A fundamental understanding of the effects of changes to these variables, and to changes in design/performance requirements, is necessary to achieve a balanced design. At the Defence Evaluation and Research Agency (DERA) this is achieved with the help of conceptual design and optimisation programs, developed and used extensively over the past 20 years or so. These Multi-Variate Optimisation (MVO) programs are rapid assessment tools, enabling the effects of variations in design variables and performance requirements, in terms of overall aircraft sizing and geometric shape. to be quickly demonstrated. The programs are used routinely within the Air Vehicle Performance Group at DERA to conduct trade-off studies. These include assessments of the benefits of new technologies (e.g. in the fields of structures, aerodynamics or engines) and the impact of setting various levels of performance requirement. The results provide information and advice to the military customer, aiding balance of investment decisions and helping with initial concept definition.
Author
Design Analysis; Aircraft Design; Fighter Aircraft

20000061428 Dassault Aviation, Saint-Cloud, France
Multi-Disciplinary Constraints in Aerodynamic Design
Perrier, P., Dassault Aviation, France; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 10-1 - 10-12; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

A long tradition of aerodynamic design of combat vehicles shows that the expression of the targets and the constraints in the design are always difficult to select. Present long iteration processes hide such variable target/constraints continuous reassessment. Every processes of design unable to have flexibility in target/constraint handling is unusable. Fortunately, the geometrical constraints are now better handled in new CAD software with features modeling. The present development of new constrained features modeling will be described from its basic expression to the more complex and variable topology configuration. Fitting the optimization process to the physics of multidisciplinary constraints may not be as easy as for geometry. It is proposed to select a family of constrained variations of geometry, each able to cope with a specific physical optimization and to generate a multiprojection of the multi-constrained operators. Some conceptual examples of such processes will be presented in the case of aeroelastic design electromagnetic design and actively controlled configurations with variable geometry for improvement of flow control. The specific domains of use of deterministic and stochastic (genetic) algorithm and of self-adaptation by training (neural network) will be assessed. New strategies will be proposed for sharing the work of optimization between different companies cooperating to the design of advanced aerospace vehicles.
Author
Aerodynamics; Design Analysis; Active Control; Aerospace Vehicles; Complex Variables; Computer Aided Design

20000061429 British Aerospace Public Ltd. Co., Military Aircraft and Aerostructures, Warton, UK
Aspects of Aerodynamic Optimisation for Military Aircraft Design
Probert, B., British Aerospace Public Ltd. Co., UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 11-1 - 11-12; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

The paper considers the role of various optimisation strategies in the aerodynamic design of military combat aircraft. The multi - design point targets of military aircraft implies that the final product must achieve a carefully judged balance between, often conflicting, requirements. The current established way of working to achieve this "balance" is first reviewed including the use of rule based procedures, the application of linearised CFD codes in both direct and inverse/optimisation modes, and the role of initial experimental data leading on to more detailed CFD work and experimental verification. Practical examples are given

relating to the design of various projects including the Experimental Aircraft Programme (EAP), which was the forerunner of Eurotighter. The need for improvements is identified, being primarily brought about by considerations of affordability and reduced design cycle time and also by the challenge posed from novel configurations to met low observability requirements. The means of achieving these improvements is discussed, and these imply the development of Multi Disciplinary Optimisation (MDO) in a wide sense. Numerical optimisation experience is reviewed but it is strongly emphasised that there is a need for rapid experimental input to the configuration design choice programme. Means of achieving this are discussed and examples given. The high incidence requirements have a strong impact on CFD developments and areas of improvement are identified. This leads to a proposed new way of working implying a much stronger interaction between the initial and detailed design phases of aircraft design.
Author
Aircraft Design; Optimization; Aerodynamics; Computational Fluid Dynamics

20000061430 Defence Evaluation Research Agency, Aerodynamics and Hydrodynamics Centre, Farnborough, UK
Progress Towards a Multi-disciplinary Analysis and Optimisation Capability for Air Vehicle Assessment and Design: A UK Research Establishment View
Lovell, David, Defence Evaluation Research Agency, UK; Bartholomew, Peter, Defence Evaluation Research Agency, UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 12-1 - 12-11; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

This paper considers progress towards establishing a Multi-disciplinary Design Optimisation (MDO) capability for assessment and design. Some basic questions are posed and answered on the basis of experience gained by DERA as a result of participation in a series of recent National and International projects undertaken in partnership with UK and European industry and government research agencies. Issues addressed include the definition of MDO: its function within concurrent engineering: the role of product models; the definition and execution of the MD0 process under users control; the use of trade-off studies for requirements capture: and the degree to which MD0 can support detailed design work. The need for the adoption of standards in the definition of the product model is highlighted.
Author
Design Analysis; Optimization; Aircraft Design

20000061431 Defence Evaluation Research Agency, UK
The Application of Pareto Frontier Methods in the Multidisciplinary Wing Design of a Generic Modern Military Delta Aircraft
Fenwick, Steven V., Defence Evaluation Research Agency, UK; Harris, John C., Defence Evaluation Research Agency, UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 13-1 - 13-7; In English; See also 20000061419; Copyright Waived; Avail: CASI; A02, Hardcopy

As a partner in the EC Framework IV "FRONTIER" project, DERA has investigated the application of a genetic algorithm (GA) and Pareto frontier methods to optimize the trade-off between multiple design objectives. A Pareto frontier is defined as the limit of design space beyond which one attribute of a design cannot be improved without detriment to another. DERA has applied the software produced within the project to the multidisciplinary design of the wing of a generic modern military delta aircraft, to trade-off the conflicting design requirements of range and agility. This paper recounts DERA's experience of the methods as an approach to the solution of a trial multidisciplinary design and optimisation (MDO) problem together with some of the results produced. Details of the software produced within the project are provided, along with conclusions and recommendations from its use.
Author
Wings; Design Analysis; Computer Design; Genetic Algorithms

20000061436 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Design Aerodynamics, Brunswick, Germany
A System for the Aerodynamic Optimization of Three-Dimensional Configurations
Orlowski, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Tang, W., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 19-1 - 19-13; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

The paper presents a system for the aerodynamic optimization of three-dimensional configurations. This system is based on the repeated calculation of the flowfield around three-dimensional geometries by solving the Euler/Navier-Stokes equations. The basic structure of the system and the incorporated modules are described. Under the same conditions the system must provide the same solutions of classic aerodynamic optimization problems as given in literature. So the function of the system is checked with

the Rhombus airfoil and the Sears-Haack body. The potential of the system is demonstrated with current aerodynamic optimization problems.
Author
Aerodynamic Configurations; Optimization; Three Dimensional Models

20000061437 Alenia Spazio S.p.A., Divisione Aeronautica, Turin, Italy
Alenia Multidisciplinary Design Optimisation: Topics and Approaches
Selmin, V., Alenia Spazio S.p.A., Italy; Vitagliano, P. O., Alenia Spazio S.p.A., Italy; Pennavaria, A., Alenia Spazio S.p.A., Italy; Crosetta, L., Alenia Spazio S.p.A., Italy; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 20-1 - 20-6; In English; See also 20000061419
Contract(s)/Grant(s): CEC-BE95-2056; Copyright Waived; Avail: CASI; A02, Hardcopy

The purpose of this paper is to report on methods which have been developed or which are under development at Alenia Aeronautica for multidisciplinary optimum design, with particularly emphasis on aerodynamic shape design. Results of transonic 2D and 3D optimisation problems are presented.
Author
Optimization; Design Analysis; Two Dimensional Models; Three Dimensional Models

20000061438 Instituto Nacional de Tecnica Aeroespacial, Fluid Dynamics Dept., Madrid, Spain
Design and Optimization of Wings in Subsonic and Transonic Regime
Monge, Fernando, Instituto Nacional de Tecnica Aeroespacial, Spain; Jimenez–Varona, Jose, Instituto Nacional de Tecnica Aeroespacial, Spain; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 21-1 - 21-10; In English; See also 20000061419; Copyright Waived; Avail: CASI; A02, Hardcopy

For a realistic and practical aerodynamic optimization the most appropriate combination of the three sets of tools taking part in the process should be carefully studied. That is, the optimization should allow an easy implementation of constraints, and should be multipoint without the need to prescribe pressure distributions in the objective function; the design space should be broad enough; and the analysis tool should be fast and robust. Taking into account these criteria, a code for multipoint design and optimization of wings in subsonic and transonic regime has been developed and will be described in this paper. The objective can be any combination of the global aerodynamic coefficients, and geometrical and physical constraints can be applied. Results for subsonic and transonic cases will be presented. Flexibility in the use of the design variables allows many different tests to be performed before the best solution is achieved. Lastly, the computational cost is reduced by the use of a low level code for computing the aerodynamic coefficients.
Author
Wings; Design Analysis; Optimization; Subsonic Flow; Transonic Flow

20000061439 Italian Aerospace Research Center, Capua, Italy
A Multiobjective Approach to Transonic Wing Design by Means of Genetic Algorithms
Vicini, A., Italian Aerospace Research Center, Italy; Quagliarella, D., Italian Aerospace Research Center, Italy; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 22-1 - 22-12; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

In this work a transonic wing design problem is faced by means of a multiobjective genetic algorithm, and using a full potential flow model. The applications here presented regard both planform and wing section optimization. It is shown how both geometric and aerodynamic constraints can be taken into account, and how the multiobjective approach to optimization can be an effective way to handle conflicting design criteria. An interpolation technique allowing a better approximation of Pareto fronts is described. Two possible ways of improving the computational efficiency of the genetic algorithm, namely a parallel implementation of the code and a hybrid optimization approach, are presented.
Author
Aircraft Design; Wings; Design Analysis; Transonic Flow; Genetic Algorithms

20000061440 National Research Council of Canada, Aerodynamics Lab., Ottawa, Ontario Canada
Application of Micro Genetic Algorithms and Neural Networks for Airfoil Design Optimization
Tse, Daniel C. M., National Research Council of Canada, Canada; Chan, Louis Y. Y., National Research Council of Canada, Canada; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 23-1 - 23-11; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

Genetic algorithms are versatile optimization tools suitable for solving multi-disciplinary optimization problems in aerodynamics where the design parameters may exhibit multi-modal or non-smooth variations. However, the fitness evaluation phase of the algorithms casts a large overhead on the computational requirement and is particularly acute in aerodynamic problems where time-consuming CFD methods are needed for evaluating performance. Methods and strategies to improve the performance of basic genetic algorithms are important to enable the method to be useful for complicated three-dimensional or multi-disciplinary problems. Two such methods are studied in the present work: micro genetic algorithms and artificial neural networks. Both methods are applied to inverse and direct airfoil design problems and the resulting improvement in efficiency is noted and discussed.
Author
Genetic Algorithms; Neural Nets; Airfoils; Design Analysis; Optimization

20000061441 Daimler-Benz Aerospace A.G., Munich, Germany
Multi-Objective Aeroelastic Optimization
Stettner, M., Daimler-Benz Aerospace A.G., Germany; Haase, W., Daimler-Benz Aerospace A.G., Germany; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 24-1 - 24-8; In English; See also 20000061419
Contract(s)/Grant(s): ESPRDIT Proj. 20082; Copyright Waived; Avail: CASI; A02, Hardcopy

The present work is aiming at an aeroelastic analysis of the X31 delta wing and particularly at the aeroelastic optimization problem of maximizing the aerodynamic roll rate and minimizing the structural weight at supersonic flow speeds. Results are achieved by means of a multi-objective genetic algorithm (GA) utilizing a GUI-supported software being developed in the European-Union funded ESPRIT project FRONTIER.
Author
Aeroelasticity; Optimization; Delta Wings; Genetic Algorithms

20000061442 NASA Marshall Space Flight Center, Huntsville, AL USA
Emergent Aerospace Designs Using Negotiating Autonomous Agents
Deshmukh, Abhijit, Massachusetts Univ., USA; Middelkoop, Timothy, Massachusetts Univ., USA; Krothapalli, Anjaneyulu, Florida State Univ., USA; Smith, Charles, NASA Marshall Space Flight Center, USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 25-1 - 25-8; In English; See also 20000061419
Contract(s)/Grant(s): NAG2-1114; NSF ARC-99-78923; Copyright Waived; Avail: CASI; A02, Hardcopy

This paper presents a distributed design methodology where designs emerge as a result of the negotiations between different stake holders in the process, such as cost, performance, reliability, etc. The proposed methodology uses autonomous agents to represent design decision makers. Each agent influences specific design parameters in order to maximize their utility. Since the design parameters depend on the aggregate demand of all the agents in the system, design agents need to negotiate with others in the market economy in order to reach an acceptable utility value. This paper addresses several interesting research issues related to distributed design architectures. First, we present a flexible framework which facilitates decomposition of the design problem. Second, we present overview of a market mechanism for generating acceptable design configurations. Finally, we integrate learning mechanisms in the design process to reduce the computational overhead.
Author
Decomposition; Design Analysis; Systems Engineering; Decision Making; Architecture; Structural Design

20000061445 Loughborough Univ. of Technology, Dept. of Aeronautical and Automotive Engineering, UK
Design Tools for Performance Assessment of Fighter Aircraft Incorporating New Technologies
Kutschera, Anthony, Loughborough Univ. of Technology, UK; Render, Peter M., Loughborough Univ. of Technology, UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 29-1 - 29-9; In English; See also 20000061419; Copyright Waived; Avail: CASI; A02, Hardcopy

The performance assessment of modern fighter aircraft has been the subject of considerable research in recent years. A new metric called Nodal Maneuver Analysis has been proposed, which allows performance assessment of new technologies to be carried out during the conceptual/preliminary design stages of an aircraft. This paper seeks to demonstrate the uses of the Nodal Maneuver Analysis metric by considering three case studies. These studies assess the changes in performance of a baseline aircraft in a vertical turn maneuver, when new technology is incorporated. The technologies are 1) an increase in thrust, 2) a reduction

in weight, and 3) the incorporation of Thrust Vectoring and Post Stall Maneuverability. Through these studies, it is shown that Nodal Maneuver Analysis can quantify the advantages/disadvantages of incorporating new technology into the design.
Author
Design Analysis; Software Development Tools; Performance Prediction; Fighter Aircraft; Technology Assessment

20000061447 Aerospatiale, Matra Missiles, Chatillon, France
Inlet/Body Integration Preliminary Design for Supersonic Air-Breathing Missiles Using Automated Multi-Disciplinary Optimization
Kergaravat, Yan, Aerospatiale, France; Vives, Eric, Aerospatiale, France; Knight, Doyle, Rutgers - The State Univ., USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 31-1 - 31-12; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

In order to reduce the design cycle time and cost and to improve the multi-disciplinary interactions at the preliminary design stage of supersonic air-breathing missiles, an automated optimization method has been developed for inlet/body integration in a concurrent engineering environment. Three disciplines of higher relevance have been considered for the shape optimization problem: propulsion, aerodynamics and electromagnetics. This paper describes the numerical method, which incorporates a genetic algorithm and three analysis modules into the optimization loop. The parametric model of the generic missile is presented. The optimization problem is defined and solved for a given mission and set of specifications. The problem is addressed in three phases corresponding to an increasing number of concurrent disciplines. This progression enables to emphasize the conflicting goals between the disciplines and to understand how the optimizer yields the best compromises. This preliminary study shows interesting results and strong potential for future development and industrial applications.
Author
Air Breathing Engines; Concurrent Engineering; Genetic Algorithms; Design Analysis; Optimization; Procedures; Supersonic Inlets

20000061449 British Aerospace Public Ltd. Co., Mathematical Modelling Dept., Bristol, UK
Rapid Aerodynamic Data Generation Using an Iterative Approximation Method
Toomer, C. A., British Aerospace Public Ltd. Co., UK; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 33-1 - 33-11; In English; See also 20000061419; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

Aerodynamic design and optimisation is a costly and complicated process in which numerically generated information about the design space plays a vital role. Hence the information needs to be of good quality, i.e. describing the correct physics, and to be easily accessible from databases using standardised formats. to make this process affordable and efficient, the codes must be fast, robust and accurate. Aerodynamic design problems tend to involve a large number of design parameters and constraints on the design. Large data sets are generated and so it is wise to automate the data generating and processing whenever possible. Data generation is only part of the process. Efficient algorithms to access and interpret the data are required, as is an efficient means of negotiating through the design space. Optimisation is the usual method by which the data are analysed, and regions within the design space identified as possible design solutions or improvements to existing designs.
Author
Aerodynamics; Data Bases; Data Processing; Design Analysis; Optimization

20000061450 Naples Univ., Dipartimento di Progettazione Aeronautica, Italy
Design and Aerodynamic Optimization of a New Reconnaissance Very Light Aircraft through Wind-Tunnel Tests
Giordano, V., Naples Univ., Italy; Coiro, D. P., Naples Univ., Italy; Nicolosi, F., Naples Univ., Italy; DiLeo, L., Naples Univ., Italy; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 34-1 - 34-8; In English; See also 20000061419; Copyright Waived; Avail: CASI; A02, Hardcopy

Design of a new Very Light Aircraft (V.L.A.) called G97 Spotter has been carried out at DPA (Department of Aeronautical Engineering) and an extensive wind tunnel test campaign has been performed on both aircraft and airfoil models. Wind tunnel tests have guided in the design phase allowing configuration optimization. Effects of nacelle and air intake shape, fuselage stretching, wing incidence and flap/aileron effectiveness have been analyzed through wind tunnel tests. The airfoil has also been designed and modified with the help of wind tunnel test results obtained for a model. Optimization of the airfoil leading edge shape has been done and has brought to a sensible drag reduction at high speed conditions. Optimization of the air intake shape on the aircraft model has been performed leading to a configuration characterized by lower drag. Influence of an air intake fairing has

been analyzed and tested through wind tunnel tests. Wing stall path has been studied. Importance of wind tunnel tests as a device to analyze and design light aircraft configuration has been highlighted.
Author
Aerodynamic Stalling; Design Analysis; Ailerons; Aircraft Models; Drag Reduction; Light Aircraft; Optimization; Wind Tunnel Tests

20000061965 Colorado Univ., Dept. of Aerospace Engineering Sciences, Boulder, CO USA
User's Manual for LINER: FORTRAN Code for the Numerical Simulation of Plane Wave Propagation in a Lined Two-Dimensional Channel
Reichert, R, S., Colorado Univ., USA; Biringen, S., Colorado Univ., USA; Howard, J. E., Colorado Univ., USA; Apr. 07, 1999; 55p; In English
Contract(s)/Grant(s): NAG1-1864; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

LINER is a system of FORTRAN 77 codes which performs a 2D analysis of acoustic wave propagation and noise suppression in a rectangular channel with a continuous liner at the top wall. This new implementation is designed to streamline the usage of the several codes making up LINER, resulting in a useful design tool. Major input parameters are placed in two main data files, input.inc and nurn.prm. Output data appear in the form of ASCII files as well as a choice of GNUPLOT graphs. Section 2 briefly describes the physical model. Section 3 discusses the numerical methods; Section 4 gives a detailed account of program usage, including input formats and graphical options. A sample run is also provided. Finally, Section 5 briefly describes the individual program files.
Author
Applications Programs (Computers); Wave Propagation; User Manuals (Computer Programs); Numerical Analysis; Noise Reduction

20000062846 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne Australia
Development of a Stress Transfer Function for an Idealised Helicopter Structure
Polanco, Frank G.; Mar. 2000; 74p; In English
Report No.(s): AD-A377442; DSTO-RR-0171; DODA-AR-011-237; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report presents an investigation of the effects that may have an influence on the development of a linear stress transfer function (STF) relating the stress in dynamic components to the stress in static components. Effects such as buckling, non-uniqueness, vibration, and solution procedure are considered. Two procedures for determining the STF are compared, one termed the vector procedure and the other the matrix procedure. A simple two dimensional truss, which models an idealised helicopter structure, is constructed to numerically simulate the development of a STF. Using random inputs the resulting stresses are evaluated exactly. Noise is then added to both the input loads and output stresses to develop a noisy data set. Using this noisy data set, STFs are developed using both the vector and matrix techniques. The vector procedure is shown to be sensitive to collinearity in the input, while the matrix technique is found to be more stable under the same ill-conditioning.
DTIC
Stress Analysis; Stress Functions; Fracturing; Euler Buckling; Helicopters

20000064011 NASA Dryden Flight Research Center, Edwards, CA USA
The SR-71 Test Bed Aircraft: A Facility for High-Speed Flight Research
Corda, Stephen, NASA Dryden Flight Research Center, USA; Moes, Timothy R., NASA Dryden Flight Research Center, USA; Mizukami, Masashi, NASA Dryden Flight Research Center, USA; Hass, Neal E., NASA Dryden Flight Research Center, USA; Jones, Daniel, NASA Dryden Flight Research Center, USA; Monaghan, Richard C., NASA Dryden Flight Research Center, USA; Ray, Ronald J., NASA Dryden Flight Research Center, USA; Jarvis, Michele L., NASA Dryden Flight Research Center, USA; Palumbo, Nathan, NASA Dryden Flight Research Center, USA; June 2000; 38p; In English
Contract(s)/Grant(s): RTOP 529-70-14
Report No.(s): NASA/TP-2000-209023; NAS 1.60:209023; H-2405; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The SR-71 test bed aircraft is shown to be a unique platform to flight-test large experiments to supersonic Mach numbers. The test bed hardware mounted on the SR-71 upper fuselage is described. This test bed hardware is composed of a fairing structure called the "canoe" and a large "reflection plane" flat plate for mounting experiments. Total experiment weights, including the canoe and reflection plane, as heavy as 14,500 lb can be mounted on the aircraft and flight-tested to speeds as fast as Mach 3.2 and altitudes as high as 80,000 ft. A brief description of the SR-71 aircraft is given, including details of the structural modifications

to the fuselage, modifications to the J58 engines to provide increased thrust, and the addition of a research instrumentation system. Information is presented based on flight data that describes the SR-71 test bed aerodynamics, stability and control, structural and thermal loads, the canoe internal environment, and reflection plane flow quality. Guidelines for designing SR-71 test bed experiments are also provided.
Author
SR-71 Aircraft; Flight Tests; Aerodynamic Stability; Test Stands; Fuselages; Structural Design

20000064050 Department of Defense, Office of the Inspector General, Arlington, VA USA
Quick-Reaction Report on the Acquisition of the F-15 Downsized Tester
Jun. 30, 1993; 66p; In English
Report No.(s): AD-A376228; IG/DOD-93-138; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The Air Force is procuring an F-15 Downsized Tester (the Tester) to replace existing automatic test equipment for the F-15 aircraft. The Tester will be a portable automatic test equipment system for testing a portion of the electronic equipment on the F-15 aircraft at the intermediate maintenance level. The Tester will initially replace the F-15 Avionics Intermediate Shop test equipment that has been in operation since 1974. Later the Tester will replace the F-15E Mobile Electronic Test Set used on the F-13E model aircraft since 1986. The audit was requested by the Director, Weapon Support Improvement Group, Office of the Assistant Secretary of Defense (Production and Logistics). The Air Force plans to award a contract for 167 million for 55 units of automatic test equipment over the 6-year Future Years Defense Program (FY 1992 through FY 1997).
DTIC
Electronic Equipment; Portable Equipment; Automatic Test Equipment

20000064593 NASA Langley Research Center, Hampton, VA USA
Session on High Speed Civil Transport Design Capability Using MDO and High Performance Computing
Rehder, Joe, NASA Langley Research Center, USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Since the inception of CAS in 1992, NASA Langley has been conducting research into applying multidisciplinary optimization (MDO) and high performance computing toward reducing aircraft design cycle time. The focus of this research has been the development of a series of computational frameworks and associated applications that increased in capability, complexity, and performance over time. The culmination of this effort is an automated high-fidelity analysis capability for a high speed civil transport (HSCT) vehicle installed on a network of heterogeneous computers with a computational framework built using Common Object Request Broker Architecture (CORBA) and Java. The main focus of the research in the early years was the development of the Framework for Interdisciplinary Design Optimization (FIDO) and associated HSCT applications. While the FIDO effort was eventually halted, work continued on HSCT applications of ever increasing complexity. The current application, HSCT4.0, employs high fidelity CFD and FEM analysis codes. For each analysis cycle, the vehicle geometry and computational grids are updated using new values for design variables. Processes for aeroelastic trim, loads convergence, displacement transfer, stress and buckling, and performance have been developed. In all, a total of 70 processes are integrated in the analysis framework. Many of the key processes include automatic differentiation capabilities to provide sensitivity information that can be used in optimization. A software engineering process was developed to manage this large project. Defining the interactions among 70 processes turned out to be an enormous, but essential, task. A formal requirements document was prepared that defined data flow among processes and subprocesses. A design document was then developed that translated the requirements into actual software design. A validation program was defined and implemented to ensure that codes integrated into the framework produced the same results as their standalone counterparts. Finally, a Commercial Off the Shelf (COTS) configuration management system was used to organize the software development. A computational environment, CJOPT, based on the Common Object Request Broker Architecture, CORBA, and the Java programming language has been developed as a framework for multidisciplinary analysis and Optimization. The environment exploits the parallelisms inherent in the application and distributes the constituent disciplines on machines best suited to their needs. In CJOpt, a discipline code is "wrapped" as an object. An interface to the object identifies the functionality (services) provided by the discipline, defined in Interface Definition Language (IDL) and implemented using Java. The results of using the HSCT4.0 capability are described. A summary of lessons learned is also presented. The use of some of the processes, codes, and techniques by industry are highlighted. The application of the methodology developed in this research to other aircraft are described. Finally, we show how the experience gained is being applied to entirely new vehicles, such as the Reusable Space Transportation System. Additional information is contained in the original.
Author
Aircraft Design; Computational Fluid Dynamics; Computer Networks; Design Analysis; Finite Element Method; Software

20000064900 Cranfield Univ., Flight Test and Dynamics Group, Cranfield, UK
An Analysis of the Flight Dynamics of a Second Generation SST Aircraft *Interim Report*
Steer, A. J., Cranfield Univ., UK; October 1999; 86p; In English
Report No.(s): COA-9914; ISBN 1-86194-046-7; Copyright; Avail: Issuing Activity

The principal aerodynamic properties that distinguish the low speed stability, control and handling characteristics of an SCT aircraft are: (1) The requirement for relaxed longitudinal stability in order to reduce trim drag, both at higher speeds as the aerodynamic centre moves aft and to improve performance at lower speeds through reduced control surface sizing. The relaxed stability, achieved through locating the CG at the NP, results in an unconventional dynamic response on the approach characterized by a 3doscillatory mode with short period damping and phugoid like frequency combined with two real modes, one of which is unstable. (2) The low static margin when flying at low-speed coupled with the absence of a second control surface results in relatively low pitch damping, M(sub q), combined with a high pitch inertia, I(sub y). The aircraft's unaugmented longitudinal response to a control input is thus characterized by a low pitch acceleration, hence sluggish pitch response combined with a slow time to settle. Solutions include feeding back either incidence or pitch rate to restore stability and enhance the maneuver response as well as augmenting control power by providing a second pitch control surface. (3) The delta wing's low lift curve slope requiring large angles of attack on the approach in order to generate sufficient low-speed lift at the expense of considerable amounts of induced drag. Hence the aircraft flies considerably below the minimum drag speed, known as 'backside' operation, resulting in speed instability and difficult flightpath control. The effects of speed instability are that at a constant engine thrust on a -3 deg. flightpath, the short term response to an aft stick movement is an increase in height relative to the flightpath. The long-term effect is an increase in drag and consequent steepening of the flightpath. Conversely, a forward stick movement initially steepens the flightpath and in the long term, the increase in speed causes the aircraft to fly above the flightpath. These effects can be overcome by use of an auto-throttle, to control speed through engine thrust. For manual control, the technique is to control the airspeed through pitch attitude and to maintain the glide slope by adjusting engine thrust. (4) The pronounced longitudinal non-minimum phase behaviour due to the movement of large trailing edge lift producing surfaces for pitch maneuver control. With only wing trailing edge mounted elevons for pitch control, their small moment arm requires a large control deflection to generate the required pitch acceleration. The ,up' elevon results in negative lift from the control surface and an initial loss in aircraft height until the aircraft incidence is modified and total lift increased. This non-minimum phase behaviour, characterized by a positive zero in the response transfer function, results in an undershoot in flight path response. Resulting in a hesitation in height response which may result in a heavy landing if a correction is made late into the approach. (5) Significant delta wing generated ground effect resulting in some cushioning of the landing, hence reduced sink rates. However, the negative pitching moments degrade the rate of nose rotation on take-off and may prove disconcerning to the pilot when the aircraft leaves its effect. (6) The pilot's location far ahead of the undercarriage resulting in difficulty in judging mainwheel position during landing at high approach attitudes. (7) The capability to generate relatively rapid rates of roll due to the inherently low roll inertia combined with the large and effective elevon control surfaces. However, the low value of the roll damping derivative, L(sub p), leads to a large roll mode time constant since -tau(sub p) approx. = I(sub x)/L(sub p), the roll control power of the elevons is also large resulting in a tendency to over-control in roll. In addition, the rolling moment due to sideslip being a function of sweepback angle and incidence tends to oppose the demanded roll maneuver if sideslip is allowed to build hence slowing the initial response. (8) A dutch roll mode characterized by a near pure rolling oscillation due to the large value of L(sub nu) combined with a low roll inertia. In addition, it has a relatively high frequency and hence short period, requiring the mode to be adequately damped to ensure acceptable handling characteristics. (9) A large yaw/roll inertia ratio resulting in a tendency for the unaugmented aircraft to roll about the longitudinal body axis and not the velocity vector, hence degrading heading response.

Derived from text

Aerodynamic Balance; Angle of Attack; Deflection; Degradation; Drag Reduction; Dynamic Response; Minimum Drag; Undercarriages

20000066590 Department of the Navy, Washington, DC USA
Neural Network System for Estimation of Helicopter Gross Weight and Center of Gravity Location
McCool, Kelly, Inventor; Haas, David, Inventor; Nov. 16, 1999; 5p; In English; Supersedes US-Patent-Appl-SN-09042045
Patent Info.: Filed 13 Mar. 1998; US-Patent-Appl-SN-09,042,045; US-Patent-5,987,397
Report No.(s): AD-D019711; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention is directed to a helicopter health and usage monitoring system utilizing a neural network for estimating gross weight and center of gravity location from measured flight condition parameter inputs; and includes means for measuring a plurality of variable flight condition parameters during flight of he helicopter; memory means for successively receiving and

storing parameter input signals as well as estimates of gross weight and center of gravity location; and processing means responsive to the signals received from the measurement means for generating the gross weight and center of gravity location estimates.
DTIC
Center of Gravity; Helicopters; Neural Nets; Weight (Mass); Weight Measurement

20000069005 Arizona State Univ., Mechanical and Aerospace Engineering, Tempe, AZ USA
Development of a Composite Tailoring Procedure for Airplane Wings *Final Report*
Chattopadhyay, Aditi, Arizona State Univ., USA; [2000]; 113p; In English
Contract(s)/Grant(s): NAG2-908; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The quest for finding optimum solutions to engineering problems has existed for a long time. In modern times, the development of optimization as a branch of applied mathematics is regarded to have originated in the works of Newton, Bernoulli and Euler. Venkayya has presented a historical perspective on optimization in [1]. The term 'optimization' is defined by Ashley [2] as a procedure "...which attempts to choose the variables in a design process so as formally to achieve the best value of some performance index while not violating any of the associated conditions or constraints". Ashley presented an extensive review of practical applications of optimization in the aeronautical field till about 1980 [2]. It was noted that there existed an enormous amount of published literature in the field of optimization, but its practical applications in industry were very limited. Over the past 15 years, though, optimization has been widely applied to address practical problems in aerospace design [3-5]. The design of high performance aerospace systems is a complex task. It involves the integration of several disciplines such as aerodynamics, structural analysis, dynamics, and aeroelasticity. The problem involves multiple objectives and constraints pertaining to the design criteria associated with each of these disciplines. Many important trade-offs exist between the parameters involved which are used to define the different disciplines. Therefore, the development of multidisciplinary design optimization (MDO) techniques, in which different disciplines and design parameters are coupled into a closed loop numerical procedure, seems appropriate to address such a complex problem. The importance of MDO in successful design of aerospace systems has been long recognized. Recent developments in this field have been surveyed by Sobieszczanski-Sobieski and Haftka [6].
Derived from text
Wings; Design Analysis; Multidisciplinary Design Optimization; Structural Analysis; Aeroelasticity; Aerodynamics

20000069006 NASA Ames Research Center, Moffett Field, CA USA
Meteorological and Remote Sensing Applications of High Altitude Unmanned Aerial Vehicles
Schoenung, S. M., Longitude 122 West, Inc., USA; Wegener, S. S., NASA Ames Research Center, USA; [1999]; 8p; In English; 4th; 21st; International Airborne Remote Sensing, 21-24 Jun. 1999, Ottawa, Ontario, Ottawa, Ontario, Canada, Canada
Contract(s)/Grant(s): RTOP 529-10-12; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Unmanned aerial vehicles (UAVs) are maturing in performance and becoming available for routine use in environmental applications including weather reconnaissance and remote sensing. This paper presents a discussion of UAV characteristics and unique features compared with other measurement platforms. A summary of potential remote sensing applications is provided, along with details for four types of tropical cyclone missions. Capabilities of platforms developed under NASA's Environmental Research Aircraft and Sensor Technology (ERAST) program are reviewed, including the Altus, Perseus, and solar- powered Pathfinder, all of which have flown to over 57,000 ft (17 km). In many scientific missions, the science objectives drive the experimental design, thus defining the sensor payload, aircraft performance, and operational requirements. Some examples of science missions and the requisite UAV / payload system are given. A discussion of technology developments needed to fully mature UAV systems for routine operational use is included, along with remarks on future science and commercial UAV business opportunities.
Author
Experiment Design; Payloads; Pilotless Aircraft; Remote Sensing; Weather

20000069029 Naval Academy, Annapolis, MD USA
Non-Invasive Detection of CR-46 AFT Gearbox Faults Using Digital Pattern Recognition and Classification Techniques
Rex, Bryan D.; May 05, 1999; 44p; In English
Report No.(s): AD-A376843; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Currently, the USA Navy performs routine intrusive maintenance on CH-46 helicopter gearboxes in order to diagnose and correct possible fault condition. (incipient fault) which could eventually lead to gearbox failure. This type of preventative maintenance is costly and it decreases mission readiness by temporarily grounding usable helicopter. Non-invasive detection of these fault conditions would save tine and prove cost-effective in both manpower and materials. This research deals with the

development of a non-invasive fault detector through a combination of digital signal processing and artificial neural network (ANN) technology. The detector will classify incipient faults based on real-tine vibration data taken from the gearbox itself. Neural networks are systems of interconnected units that are trained to compute a specific output as a non-linear function of their inputs. For sons tine the USA Navy has been interested in the use of artificial neural networks in monitoring the health of helicopter gearboxes. In order to determine the detection sensitivity of this method in comparison with traditional invasive methods, the USN funded Westland Helicopters Ltd to conduct a series of CH-46 gearbox rig tests. In these tests, the gearbox was seeded with nine different fault conditions. This seeded fault testing provided the vibration data necessary to develop and test the feasibility of en artificial neural network for fault classification. This research deals with the formation of the pattern vectors to be used in the neural network classifier, the construction of the classification network, and an analysis of results.
DTIC
Neural Nets; Signal Processing; Digital Systems; Transmissions (Machine Elements); CH-46 Helicopter

20000069036 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Joint Strike Fighter Acquisition: Development Schedule Should Be Changed to Reduce Risks
May 2000; 32p; In English; Report to the Chairman, Subcommittee on National Security, Veterans' Affairs, and International Relations, Committee on Government Reform, House of Representatives.
Report No.(s): AD-A376878; GAO/NSIAD-00-74; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Joint Strike Fighter Program is intended to produce an affordable, next-generation aircraft to replace the Department of Defense's (DOD) aging aircraft inventory. The first aircraft deliveries are scheduled to begin in 2008. As currently planned, the program will cost about $200 billion to develop and procure over 3,000 aircraft and related support equipment for the Air Force, the Marine Corps, the Navy, and Great Britain. DOD has designated the Joint Strike Fighter Program as a flagship program for acquisition. to date, the program has awarded contracts totaling over $2 billion to Boeing and Lockheed Martin for the current concept demonstration phase. Under these contracts, both contractors will build the aircraft they plan to fly in the demonstration phase and also design the aircraft they plan to build in the next phase of the development program engineering and manufacturing development. During engineering and manufacturing development, the Joint Strike Fighter will be fully developed, engineered, designed, fabricated, tested, and evaluated to demonstrate that the production aircraft will meet stated requirements. DOD is scheduled to award the contract for engineering and manufacturing development to either Boeing or Lockheed Martin in April 2001.1 At your request, we reviewed the Joint Strike Fighter Program to (1) provide information on the acquisition strategy and (2) to determine whether the strategy is being implemented in a manner that will ensure that the acquisition strategy objectives will be achieved. The General accounting Office discussed a draft of this report during a March 16, 2000 joint hearing by the Subcommittees on Military Procurement and on Military Research and Development, House Committee on Armed Services. At the time of the hearing. GAO had not received DOD's comments on our report. This report contains DOD's comments and GAO's evaluation of these
DTIC
Aircraft Design; Military Technology; Product Development; Procurement; Manufacturing; Fighter Aircraft

20000069647 Air Force Research Lab., Air Vehicles Directorate, Wright-Patterson AFB, OH USA
Improvement and Validation of the Computational Aeroelasticity Code ENS3DAE *Final Report, 4-7 Jan. 1999*
Hawkinson, Dean; Sep. 1999; 17p; In English
Contract(s)/Grant(s): Proj-2401
Report No.(s): AD-A377584; AFRL-VA-WP-TR-1999-3086; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The heightened awareness of the importance of fluid-structures interaction has lead to the development of several tools for addressing such issues. One continually developing tool, ENS3DAE has been adopted for use by several researchers and engineers. In the interest of increased generality, additional capabilities have been implemented into the software. of these new improvements, the ability to generate a static aeroelastic solution to a two-dimensional airfoil problem using different grid topologies has been successfully completed. Originally written to use H-type grids, ENS3DAE was not able to aeroelastically deflect the two degree of freedom airfoil. After small logic modifications and adjusting a standard input file, a reasonable static aeroelastic solution was obtained. Future plans include validation of the current work and development of a dynamic aeroelastic, pitch and plunge case for the NACA airfoil.
DTIC
Aeroelasticity; Airfoils; Computer Programs

20000069840 Federal Aviation Administration, Washington, DC USA
Airworthiness Certification of Aircraft and Related Products. Order 8130.2D
Sep. 30, 1999; 274p
Report No.(s): PB2000-103115; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This order establishes procedures for accomplishing original and recurrent airworthiness certification of aircraft and related products. The procedures contained in this order apply to both Aircraft Certification Manufacturing and Flight Standards Airworthiness Aviation Safety Inspectors, and to private persons/organizations delegated authority to issue airworthiness certificates and related approvals.

NTIS
Certification; Aircraft Reliability; Flight Safety

20000069844 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
VMCA Flight Test of the Carrier-Landin', Mail-Hauling' C-2A
Wagner, Mike; Webb, Chuck; Apr. 14, 2000; 23p; In English
Report No.(s): AD-A377905; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The C-2A is a Navy, carrier-based aircraft used for the Carrier On-Board Delivery (COD) mission. The aircraft was recently equipped with an L-Probe pitot-static system. Comparison of L-Probe data with previous pitot-static data suggested that approach speeds might be below published Vmc. Analysis of original Vmc flight test suggested that actual Vmc had not been reached. Also, more mission representative Vmc techniques developed in recent years, could provide a more accurate Vmc number. Flight tests were conducted to reassess Vmc using the L-probes as the primary pitot-Static source. Vmc tests were conducted in 10 flights, 23 hours and included over 40 actual engine shutdowns. Both the Classic (FTM-103) and Waveoff techniques were used during the flight test. The techniques were conducted at intermediate airspeed ranges for comparative purposes. Both techniques required additional analysis and clarification to ensure minimal airspeed change from the time the engine was secured to the time initial control inputs were made and subsequent. Several other techniques/test conditions were employed to ensure a more conservative Vmc number and proper mission relation. Finally, new airspeed data evaluation considerations helped provide final Vmc numbers for fleet use. The lower Vmc number will permit approach to landings over a broader weight range. The C-2A Vmc test effort not only yielded new, more accurate Vmc numbers for the C-2A aircraft, it also yielded many lessons learned that will be of assistance to future Vmc testers.

DTIC
Transport Aircraft; Aircraft Carriers

20000069848 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Defense Acquisitions: F/A-18E/F Aircraft Does Not Meet All Criteria for Multilayer Procurement
Kuhta, Steven; May 2000; 29p; In English
Report No.(s): AD-A377914; GAO/NSIAD-00-158; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Although the F/A-18E/F met its key performance parameters, such as range and carrier suitability, the operational testers' comparisons of the F/A-18E/F to the existing F/A-18C showed that the F/A-18E/F did not demonstrate superior operational performance over the existing F/A-18C aircraft. The testers compared the operational effectiveness of the F/A-18C6 to the F/A-18E/F in 18 operational mission areas such as interdiction, fighter escort, combat air patrol, air combat maneuvering, and air-to-air weapons. Using a numerical scale, the testers rated the F/A-18E/F's operational effectiveness essentially the same as the F/A-18C's.

DTIC
System Effectiveness; F-18 Aircraft; Maneuvers; Procurement

20000069862 Army War Coll., Carlisle Barracks, PA USA
Teaching a New Dog Old Tricks: Replacing Man with Artificial Intelligence in Combat Aircraft
Flade, John W.; Apr. 01, 2000; 36p; In English
Report No.(s): AD-A377623; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

By 2025 the U.S. is counting on the Joint Strike Fighter (JSF) to be the backbone of its offensive aerial arm. JSF, with a service life of 40 to 50 years, is expected to replace the F-16 and A-10 in the USAF-inventory. For the U.S. Marine Corps, JSF will take the place of the AV-8 and F-18. The U.S. Navy needs JSF for long range strike as a replacement for the F-14 and F-18. All told, the U.S. intends to buy a stupendous number of JSFs-nearly 3,000 aircraft! Yet, increasing computer power affords the U.S. the option of replacing manned strike aircraft with an uninhabited combat aerial vehicle (UCAV). Without a pilot, the UCAV offers tremendous increases in lethality and survivability. The enhanced effectiveness of modern air defense systems, coupled with the

high cost of crewed aircraft and the increasing value placed on human life is forcing the adoption of unmanned aerial vehicles for the combat role. This paper takes the position that at the current pace of technological advancement the UCAV will provide the USA with a cornerstone combat capability far exceeding that of the JSF by 2016. UCAV capacity will render JSF obsolete far ahead of its service life.
DTIC
Fighter Aircraft; Pilotless Aircraft; Artificial Intelligence; Automatic Flight Control

20000070332 Naval Postgraduate School, Monterey, CA USA
Full Nonlinear Simulation of Helicopter Coupled Rotor-Fuselage Motion Using MATLAB Symbolic Processor and Dynamic Simulation
Weissenfels, Robert D.; Mar. 2000; 111p; In English
Report No.(s): AD-A377881; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
This thesis formulates the full nonlinear equations of motion for determining the stability of helicopter coupled rotor-fuselage motion utilizing MATLAB(registered)'s Symbolic Math Toolbox. Using the extended symbolic processor toolbox, the goal of this work was to eliminate the time consuming process of convening FORTRAN or C code generated by the symbolic processor, MAPLE(registered) into a MATLAB(registered) useable format where it is further incorporated into an
DTIC
Equations of Motion; Fuselages; Applications Programs (Computers); Rotary Wings

20000070448 Arizona State Univ., Dept. of Mechanical and Aerospace Engineering, Tempe, AZ USA
An Enhanced Multi-Objective Optimization Technique for Comprehensive Aerospace Design, ***15 Jul. 1998 - 14 Jan. 2000***
Chattopadhyay, Aditi, Arizona State Univ., USA; Rajadas, John N., Arizona State Univ., USA; [2000]; 28p; In English
Contract(s)/Grant(s): NCC2-1000; NCC2-5150; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
An enhanced multiobjective formulation technique, capable of emphasizing specific objective functions during the optimization process, has been demonstrated on a complex multidisciplinary design application. The Kreisselmeier-Steinhauser (K-S) function approach, which has been used successfully in a variety of multiobjective optimization problems, has been modified using weight factors which enables the designer to emphasize specific design objectives during the optimization process. The technique has been implemented in two distinctively different problems. The first is a classical three bar truss problem and the second is a high-speed aircraft (a doubly swept wing-body configuration) application in which the multiobjective optimization procedure simultaneously minimizes the sonic boom and the drag-to-lift ratio (C(sub D)/C(sub L)) of the aircraft while maintaining the lift coefficient within prescribed limits. The results are compared with those of an equally weighted K-S multiobjective optimization. Results demonstrate the effectiveness of the enhanced multiobjective optimization procedure.
Author
Procedures; Aerospace Engineering; Body-Wing Configurations

20000070474 Smart Material Design, Inc., Highland Park, IL USA
Quantitative Nondestructive Evaluation and Reliability Assessment of the Aging Aircraft Structure Components ***Final Report, 1 Aug. 1999-31 Jan. 2000***
Sutin, Alexander, Smart Material Design, Inc., USA; Apr. 30, 2000; 114p; In English
Contract(s)/Grant(s): F49620-99-C-0038
Report No.(s): AD-A377667; AFRL-SR-BL-TR-00-0188; No Copyright; Avail: CASI; A02, Microfiche; A06, Hardcopy
The report developed under STTR contract presents the results of work performed on development of a new probabilistic model for reliability assessment of the aging aircraft structural components and nonlinear acoustic instrumentation for collecting the input data for reliability model. The reliability of aging components is estimated on the basis of crack propagator concept CP (probability of crack extension from one position to the next during specified time interval). Monte Carlo Simulation is employed for numerical realization. parameters of CP can be evaluated and experimentally verified by nonlinear acoustic technique and instrumentation. This instrumentation uses the interaction of ultrasonic waves with vibration (Nonlinear Elastic Wave Spectroscopy - NEWS). High sensitivity of nonlinear acoustic technique for crack detection and location was demonstrated for different class of materials: polycarbonate, steel, aluminum, adhesive bonded aluminum plates. This technique allows to estimate crack size and location that are the input parameters for the reliability model. Draft design of the instrumentation has been also developed. Phase II will pursuer advanced development of reliability model. The stationary and in-field usage nonlinear

instrumentation prototypes and software will be developed for lifetime and quantitative reliability assessment of the aging structure components.
DTIC
Aircraft Structures; Nondestructive Tests; Reliability Analysis; Structural Design; Mathematical Models

20000070484 National Aerospace Lab., Structures and Materials Div., Amsterdam, Netherlands
Design, Fabrication and Testing of a Dyneema/Polyethylene Radome for Airborne Remote Sensing
deVries, H. P. J.; Jan. 07, 1998; 20p; In English; SAMPE/JEC Conference, Apr. 1998, Paris, France
Report No.(s): PB2000-104892; NLR-TP-98005; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Most radomes consist of a solid laminate or sandwich type structure made of fiberglass reinforced plastics. The use of Dyneema (trademark of DSM) fibers in a plyethylene (PE) matrix instead of fiberglass reinforced plastics for radomes is very interesting because of excellent radar transparency of Dyneema/PE. However, because of its sensitivity for creep, applications in aerodynamically loaded structures are limited. The key problems facing their use in radomes are how to improve the mechanical properties to an acceptable level and how to mount the radome on the radar pod. This paper presents the development of a Dyneema/PE radome for airborne remote sensing. Several electrical properties and design aspects of the radome are discussed. The effect of the consolidation conditions on the creep behavior and the configuration of the mounting system are described. Test flight results are evaluted.
NTIS
Fabrication; Radomes; Remote Sensing; Composite Materials; Polyethylenes; Sandwich Structures

20000070485 National Aerospace Lab., Structures and Materials Div., Amsterdam, Netherlands
Impact Energy Absorbing Surface Layers for Protection of Composite Aircraft Structures
Hart, W. G. J.; Ubels, L. C.; Jan. 07, 1998; 24p; In English; Composite Materials, ECCM-8, 3-6 Jun. 1998, Naples, Italy
Report No.(s): PB2000-104893; NLR-TP-98002; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

In the framework of a European Defense Research Program the NLR investigated how the tolerance behavior of carbon/epoxy composite aircraft structures can be improved by application of impact energy absorbing surface layers. A promising concept of protection layers consist of a layer of an adhesive filled with glass microballoons covered with one or more layers of aluminum gauze. In an experimental test program on unprotected and protected stiffened compression panels it was proved that surface layers may prevent impact damage in the composite panel for impact energies up to 60 Joule. As compared to an unprotected component the compression failure load was increased by approximately 40 T. This benefit has to be set off against a weight penalty of 26%.
NTIS
Aircraft Structures; Composite Structures; Epoxy Matrix Composites; Shock Absorbers; Impact Resistance; Impact Damage

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

20000061968 NASA Langley Research Center, Hampton, VA USA
Developing Conceptual Hypersonic Airbreathing Engines Using Design of Experiments Methods
Ferlemann, Shelly M., NASA Langley Research Center, USA; Robinson, Jeffrey S., NASA Langley Research Center, USA; Martin, John G., NASA Langley Research Center, USA; Leonard, Charles P., NASA Langley Research Center, USA; Taylor, Lawrence W., NASA Langley Research Center, USA; Kamhawi, Hilmi, TechnoSoft, Inc., USA; [2000]; 12p; In English; 21st; Aerodynamic Measurement Technology and Ground Testing, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2000-2694; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Designing a hypersonic vehicle is a complicated process due to the multi-disciplinary synergy that is required. The greatest challenge involves propulsion-airframe integration. In the past, a two-dimensional flowpath was generated based on the engine performance required for a proposed mission. A three-dimensional CAD geometry was produced from the two-dimensional flowpath for aerodynamic analysis, structural design, and packaging. The aerodynamics, engine performance, and mass properties are inputs to the vehicle performance tool to determine if the mission goals were met. If the mission goals were not met, then a flowpath and vehicle redesign would begin. This design process might have to be performed several times to produce a "closed"

vehicle. This paper will describe an attempt to design a hypersonic cruise vehicle propulsion flowpath using a Design of' Experiments method to reduce the resources necessary to produce a conceptual design with fewer iterations of the design cycle. These methods also allow for more flexible mission analysis and incorporation of additional design constraints at any point. A design system was developed using an object-based software package that would quickly generate each flowpath in the study given the values of the geometric independent variables. These flowpath geometries were put into a hypersonic propulsion code and the engine performance was generated. The propulsion results were loaded into statistical software to produce regression equations that were combined with an aerodynamic database to optimize the flowpath at the vehicle performance level. For this example, the design process was executed twice. The first pass was a cursory look at the independent variables selected to determine which variables are the most important and to test all of the inputs to the optimization process. The second cycle is a more in-depth study with more cases and higher order equations representing the design space.
Author
Fabrication; Air Breathing Engines; Applications Programs (Computers); Computer Aided Design; Design Analysis; Experiment Design; Structural Design

20000063377 NASA Glenn Research Center, Cleveland, OH USA
The Numerical Propulsion System Simulation: An Overview
Lytle, John K., NASA Glenn Research Center, USA; June 2000; 14p; In English; Computational Aerosciences, 15-17 Feb. 2000, Moffett Field, CA, USA; Sponsored by NASA Ames Research Center, USA
Contract(s)/Grant(s): RTOP 509-10-11
Report No.(s): NASA/TM-2000-209915; E-12152; NAS 1.15:209915; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Advances in computational technology and in physics-based modeling are making large-scale, detailed simulations of complex systems possible within the design environment. For example, the integration of computing, communications, and aerodynamics has reduced the time required to analyze major propulsion system components from days and weeks to minutes and hours. This breakthrough has enabled the detailed simulation of major propulsion system components to become a routine part of designing systems, providing the designer with critical information about the components early in the design process. This paper describes the development of the numerical propulsion system simulation (NPSS), a modular and extensible framework for the integration of multicomponent and multidisciplinary analysis tools using geographically distributed resources such as computing platforms, data bases, and people. The analysis is currently focused on large-scale modeling of complete aircraft engines. This will provide the product developer with a "virtual wind tunnel" that will reduce the number of hardware builds and tests required during the development of advanced aerospace propulsion systems.
Author
Propulsion System Performance; Propulsion System Configurations; Complex Systems; Mathematical Models; Simulation

20000064592 General Electric Co., Aircraft Engines, Cincinnati, OH USA
High Bypass Turbofan Compressions System Simulations Using 3D, Parallel, Multistage CFD
Dailey, Lyle D., General Electric Co., USA; Turner, Mark G., General Electric Co., USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A parallelized set of analysis tools for turbofan system components is being used to simulate the aerodynamics through a GE high bypass turbofan compression system. The compression system has been analyzed in multiple components to improve the understanding of each individual component, as well as the interactions between components. These components include isolated blade rows, isolated stages, the fan, the low pressure compressor (or booster), and blocks of the high pressure compressor (HPC). Simulations are also planned to couple various components, such as the fan and booster and all blocks of the HPC, and to couple the entire system, comprised of fan, booster, and HPC. The individual component simulations were validated by running at respective rig conditions and comparing to rig test data. The full system simulation, which will be run at engine takeoff operating conditions, will be validated with limited test data from static turbofan tests, and by comparing the computed shaft horsepower to the engine cycle. These large-scale simulations have been made possible by utilizing parallel computing in the pre-processing and flow solver tools. The grid generation tool used for these simulations, developed at NASA Glenn Research Center, is called APG. by running APG in parallel, the grids for any component can be completed in about 20 minutes by using multiple processors. The flow solver was originally developed by John Adamcyzk's team at NASA Glenn, and later parallelized and made multiblock by GE. The simulations make use of the multiblock capabilities of APG and APNASA, allowing treatment of multiple flow regions, such as the core flow, bypass flow, and bleed flows. The grid generator and flow solver have been run at GE on a networked

system of workstations. The flow solver is also commonly run on the NASA Origin system at NASA Ames. Performance of the flow solver on the two systems will be compared. Additional information is contained in the original.
Author
Compressors; Computational Fluid Dynamics; Grid Generation (Mathematics); Parallel Processing (Computers); Turbofans; Computerized Simulation

20000064598 General Electric Co., Aircraft Engines, Cincinnati, OH USA
Integrated Multidisciplinary Design
Bailey, Michael W., General Electric Co., USA; Irani, Rohinton K., General Electric Co., USA; Finnigan, Peter M., General Electric Co., USA; Rohl, Peter J., General Electric Co., USA; Badhrinath, Krishnakumar, General Electric Co., USA; Welcome to the NASA High Performance Computing and Communications Computational Aerosciences (CAS) Workshop 2000; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

An integrated multidisciplinary approach to system design of aircraft engines has been the goal for many years. Frequently referred to as concurrent engineering, this has been a predominantly manual process since the computer structure to support it has been unavailable. Historically the approach has been to achieve this multidisciplinary integration by linking aerodynamic and structural code inputs and outputs and typically generating geometry in the form of an IGES files as required. This approach does not provide a seamless flow of information from Conceptual through to Preliminary, Detail Design and manufacturing. Simplification at the Concept and Preliminary Design phases when commitments are made to the customer are often invalidated at the Detail Design phase. This results in rework, sub-optimal designs and potentially low customer satisfaction. Master Model or Common Geometry is a geometric centric approach that provides a linked associative environment from concept to manufactured product. Here the intent is to create 3-Dimensional solid geometry at engine concept which would flow seamlessly into detail design, digital engine mockup and manufacturing. This paper describes the move towards a more integrated CAD/CAM/CAE approach based on the concept of a common geometric representation of the product being the design integrator. Everyone is familiar with the concept of building up a system from its constituent parts. Less well understood is how the system level constraints and requirements flow down to these parts with resultant feedback to the system. This has traditionally been the goal of concurrent engineering but the degree of concurrency necessary to provide optimization at the system level has never been achieved. The ultimate goal is an infrastructure that will support concurrent design by analysis. This will be complimented by robust design techniques which use a probabilistic approach to account for the uncertainty associated with a design. GEAE is currently implementing a Common Geometry infrastructure that will support the product from creation to manufacturing and ultimately engine services. This infrastructure will also support the move from deterministic to probabilistic design. Several pilot projects have been successfully completed paving the way to a successful initial implementation. An integral part of this whole process is CAD Integration with Analysis where analytical models are created by applying boundary conditions to the same geometry using context models or views of geometry. Manufacturing also uses the same geometry combined with context models to create in-process models. A prerequisite in this is the creation of 3-Dimensional parametric feature based models. The goal is to significantly shorten the design cycle not only by automation but by creating a degree of concurrency previously unachievable. Results from these pilots, the initial implementation and the productivity gains demonstrated will be discussed. GEAE initiated the Common Geometry project two years ago. The ground rules were that the system would be Unigraphics based and be implemented in commercial software wherever possible. The Common Geometry environment should support the product creation from concept to manufacturing and ultimately services. An integral part of the system would be a Product Data Management System (PDMS) which would support the storage and retrieval of both data related directly to geometry and other metadata. This PDMS would permit the different activities to function concurrently and permit updates to flow down to all aspects of the design activity. This paper will build on the approach described in another publication. In every design there exists a performance floor and cost ceiling between which multiple solutions exist. The purpose of a design is to create a product that will provide customer satisfaction in terms of expectations and technical requirements. In the military world this is the ability to complete a specific mission and in the commercial world this is the ability to produce a revenue stream. The challenge is to translate these customer Critical to Quality requirements into hardware that will comprise a system. Consequently an understanding of the flowdown of the customer CTQ's to individual parts is essential if customer satisfaction is to be achieved. This represents the challenge in GEAE's Design For Six Sigma Initiative and is driving the shift from deterministic to probabilistic design methodologies. Common Geometry is a key enabling technology to achieving these goals. Shortening the design cycle by designing by analysis and minimizing testing will significantly reduce engine development cost and create better products. Common geometry will provide the computer infrastructure to make true concurrent engineering a reality.
Author
Computer Aided Design; Concurrent Engineering; Computerized Simulation; Three Dimensional Models

20000064602 NASA Glenn Research Center, Cleveland, OH USA

Modular Multi-Fidelity Simulation Methodology for Multiple Spool Turbofan Engines

Hall, Edward J., Rolls-Royce Allison, USA; VanDrei, Don, NASA Glenn Research Center, USA; Townsend, Scott, NASA Glenn Research Center, USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

This paper describes the development of a component-based simulation environment for multiple-spool turbofan gas turbine engines. Engine performance simulations are based on coupled models of individual components (fans, compressors, combustors, turbines, nozzles, etc.) employing multiple levels of fidelity. During the course of the simulation, the performance of each component may be derived through computational models of varying levels of fidelity including: (1) 0-D performance map lookup (2) Steady 2-D CFD analysis (3) Steady 3-D CFD analysis (4) Time-dependent 3-D CFD analysis This study builds on previous efforts directed at whole engine performance simulation which modeled the low pressure (LP) and high pressure (HP) components separately, using different solution methodologies. The ultimate strategy in the current development effort is to provide an environment whereby the traditional model for engine performance simulations (the cycle analysis) can be extended to provide the level of fidelity available in modern three-dimensional turbomachinery CFD codes. Traditional cycle analysis provides a representative framework for the overall engine simulation whereby individual components are represented via zero-dimensional block elements. The performance of each element is traditionally computed based on table or map look-up. This is the essential capability provided in the Numerical Propulsion System Simulation (NPSS Version 1.0) at it's lowest level of fidelity. The interest in the current study lies in extending the level of fidelity available in each of the block components to three dimensions and beyond. This capability enhancement is derived from computational results from the ADPAC CFD code based on realistic 3-D component models of each of the block elements in the engine cycle analysis. The simulation environment exploits paralellism at several different levels. Individual CFD simulations employ multiple processors and provide message passing between individual blocks of a single component simulation. Coupled simulations of multiple components provide yet another level of parallelism. Finally, simultaneous low-fidelity and high-fidelity simulations yield yet another opportunity for parallelism. Simulation models have been developed and applied to two modem engine designs: the General Electric Energy Efficient Engine (EEE) and the Rolls-Royce Allison AE3007 engine. Both of these engines employ a dual spool configuration (separate spools for HP and LP components). Low fidelity (0-D) NPSS models were developed for each of these engine configurations. Simultaneously, high fidelity CFD models (3-D) were also developed on a component by component basis. Cooperative simulation between codes with varying levels of physics is provided through sophisticated inter-code communication environments using the CORBA data exchange model. Both JAVA-based and C++-based executive programs have been developed to drive the overall simulation employing mixed models of component representation. The system has been demonstrated for performance simulations of both the EEE and AE3007 engines to explore the multidisciplinary aspects of the simulation environment. Both aerodynamic and mechanical coupling are provided between common shaft-mounted components via a shaft power balance procedure. Dual spool shaft power balance procedures based on 3-D CFD results have also been developed to provide a nearly complete 3-D representation of the entire engine flowfield. Additional information is contained in the original.

Author

Computational Fluid Dynamics; Computerized Simulation; Gas Turbine Engines; Mathematical Models; Simulation; Turbofan Engines; Turbomachinery

20000064604 ASE Technologies, Inc., Cincinnati, OH USA

Multi-Stage Simulation of Advanced Gas Turbine Engines

Vitt, Paul, ASE Technologies, Inc., USA; Subramanian, S. Mani, ASE Technologies, Inc., USA; Cherry, David, General Electric Co., USA; Turner, Mark, General Electric Co., USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Next generation gas turbine engines are being developed to increase thrust and fuel economy, and to be environmentally friendly, all while reducing cost and weight, for both military and commercial applications. NASA's Ultra Efficient Engine Technology (UEET), and DoD's Integrated High Performance Turbine Engine Technology (IHPTET) and Joint Technology Advanced Gas Generator (JTAGG) programs, are supporting these technology goals. The beneficiaries of these developmental programs include commercial aircraft, such as the Boeing 737NG and the Next Generation Regional Transport, and military programs like the Joint Strike Fighter (JSF). to support these technology programs related to propulsion systems, advanced computational fluid dynamics methods that simulate entire components of gas turbines are being developed. by integrating the results of these calculations early in the design cycle, the engine designer can investigate areas where the engine weight and complexity can be reduced or aerodynamic efficiency improved. The individual blade rows that comprise a gas turbine engine significantly interact with their surrounding blade rows, and the interaction effect can be tuned by the designer to provide aerodynamic performance improvement. The current computational fluid dynamics analyses are focusing on including all of the

blade rows within a turbine component, such as the booster and high pressure compressor or the high and low pressure turbines. Once the performance of the component system is known, the effect of design changes for increased performance or reduced weight can be estimated. Calculating all of the individual aerodynamic contributions of the airfoils in a compressor or turbine is a computationally intensive task, and highly-parallel processing techniques are the best current approach to reducing the time required for an analysis. The HPCCP computational resource has been used as a testbed to demonstrate the capability to simulate the flow in a complete compressor or turbine, and to address design issues relevant to integrating the aerodynamic components in a timely manner.
Author
Computational Fluid Dynamics; Gas Turbine Engines; Parallel Processing (Computers); Computerized Simulation

20000064618 NASA Glenn Research Center, Cleveland, OH USA
Probabilistic Multi-Scale, Multi-Level, Multi-Disciplinary Analysis and Optimization of Engine Structures
Chamis, Christos C., NASA Glenn Research Center, USA; Abumeri, Galib H., DYNACS Engineering Co., Inc., USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Aircraft engines are assemblies of dynamically interacting components. Engine updates to keep present aircraft flying safely and engines for new aircraft are progressively required to operate in more demanding technological and environmental requirements. Designs to effectively meet those requirements are necessarily collections of multi-scale, multi-level, multi-disciplinary analysis and optimization methods and probabilistic methods are necessary to quantify respective uncertainties. These types of methods are the only ones that can formally evaluate advanced composite designs which satisfy those progressively demanding requirements while assuring minimum cost, maximum reliability and maximum durability. Recent research activities at NASA Glenn Research Center have focused on developing multi-scale, multi-level, multidisciplinary analysis and optimization methods. Multi-scale refers to formal methods which describe complex material behavior metal or composite; multi-level refers to integration of participating disciplines to describe a structural response at the scale of interest; multidisciplinary refers to open-ended for various existing and yet to be developed discipline constructs required to formally predict/describe a structural response in engine operating environments. For example, these include but are not limited to: multi-factor models for material behavior, multi-scale composite mechanics, general purpose structural analysis, progressive structural fracture for evaluating durability and integrity, noise and acoustic fatigue, emission requirements, hot fluid mechanics, heat-transfer and probabilistic simulations. Many of these, as well as others, are encompassed in an integrated computer code identified as Engine Structures Technology Benefits Estimator (EST/BEST) or Multi-faceted/Engine Structures Optimization (MP/ESTOP). The discipline modules integrated in MP/ESTOP include: engine cycle (thermodynamics), engine weights, internal fluid mechanics, cost, mission and coupled structural/thermal, various composite property simulators and probabilistic methods to evaluate uncertainty effects (scatter ranges) in all the design parameters. The objective of the proposed paper is to briefly describe a multi-faceted design analysis and optimization capability for coupled multi-discipline engine structures optimization. Results are presented for engine and aircraft type metrics to illustrate the versatility of that capability. Results are also presented for reliability, noise and fatigue to illustrate its inclusiveness. For example, replacing metal rotors with composites reduces the engine weight by 20 percent, 15 percent noise reduction, and an order of magnitude improvement in reliability. Composite designs exist to increase fatigue life by at least two orders of magnitude compared to state-of-the-art metals.
Author
Aircraft Engines; Design Analysis; Multidisciplinary Design Optimization; Engine Design

20000064624 NASA Glenn Research Center, Cleveland, OH USA
Numerical Propulsion System Simulation: An Overview
Lytle, John K., NASA Glenn Research Center, USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The cost of implementing new technology in aerospace propulsion systems is becoming prohibitively expensive and time consuming. One of the main contributors to the high cost and lengthy time is the need to perform many large-scale hardware tests and the inability to integrate all appropriate subsystems early in the design process. The NASA Glenn Research Center is developing the technologies required to enable simulations of full aerospace propulsion systems in sufficient detail to resolve critical design issues early in the design process before hardware is built. This concept, called the Numerical Propulsion System Simulation (NPSS), is focused on the integration of multiple disciplines such as aerodynamics, structures and heat transfer with computing and communication technologies to capture complex physical processes in a timely and cost-effective manner. The vision for NPSS, as illustrated, is to be a "numerical test cell" that enables full engine simulation overnight on cost-effective computing platforms. There are several key elements within NPSS that are required to achieve this capability: 1) clear data

interfaces through the development and/or use of data exchange standards, 2) modular and flexible program construction through the use of object-oriented programming, 3) integrated multiple fidelity analysis (zooming) techniques that capture the appropriate physics at the appropriate fidelity for the engine systems, 4) multidisciplinary coupling techniques and finally 5) high performance parallel and distributed computing. The current state of development in these five area focuses on air breathing gas turbine engines and is reported in this paper. However, many of the technologies are generic and can be readily applied to rocket based systems and combined cycles currently being considered for low-cost access-to-space applications. Recent accomplishments include: (1) the development of an industry-standard engine cycle analysis program and plug 'n play architecture, called NPSS Version 1, (2) A full engine simulation that combines a 3D low-pressure subsystem with a 0D high pressure core simulation. This demonstrates the ability to integrate analyses at different levels of detail and to aerodynamically couple components, the fan/booster and low-pressure turbine, through a 3D computational fluid dynamics simulation. (3) Simulation of all of the turbomachinery in a modern turbofan engine on parallel computing platform for rapid and cost-effective execution. This capability can also be used to generate full compressor map, requiring both design and off-design simulation. (4) Three levels of coupling characterize the multidisciplinary analysis under NPSS: loosely coupled, process coupled and tightly coupled. The loosely coupled and process coupled approaches require a common geometry definition to link CAD to analysis tools. The tightly coupled approach is currently validating the use of arbitrary Lagrangian/Eulerian formulation for rotating turbomachinery. The validation includes both centrifugal and axial compression systems. The results of the validation will be reported in the paper. (5) The demonstration of significant computing cost/performance reduction for turbine engine applications using PC clusters. The NPSS Project is supported under the NASA High Performance Computing and Communications Program.
Author
Propulsion System Configurations; Computerized Simulation; Parallel Processing (Computers); Computer Aided Design; Mathematical Models; Engine Design; Distributed Processing

20000066606 Prins Maurits Lab. TNO, Rijswijk, Netherlands
Occupational Health Risks of Exhaust Gases of the F-16 During Operational Exercises with the 40L70 *Final Report Arbeidshygienische Risico's Door Uitlaatgassen uit de F-16 Tijdens Operationele Oefeningen met de 40L0*
Groeneveld, F. R., Prins Maurits Lab. TNO, Netherlands; February 2000; 26p; In Dutch; Original contains color illustrations
Contract(s)/Grant(s): A99,KLu/431; TNO Proj. 014.11168
Report No.(s): TD99-0420; PML-1999-A104; Copyright; Avail: Issuing Activity

The personnel of the canon 40L70 are feeling inconvenience by the exhaust of the F-16 positioned at the top of runway 24 at Twenthe air base during operational exercises. An unfavourable wind the exhaust gases were blowing over their fixed position of the 40L70. After measurements of several compounds of the exhaust gases the concentrations did not exceed the MAC-value at a distance of 100 meter below the wind of the F-16.
Derived from text
Exhaust Gases; Personnel; F-16 Aircraft

20000067666 NASA Glenn Research Center, Cleveland, OH USA
A Probabilistic Approach to Aeropropulsion System Assessment
Tong, Michael T., NASA Glenn Research Center, USA; Jan. 31, 2000; 8p; In English; 45th; Gas Turbine and Aeroengine Technical Congress, 8-11 May 2000, Munich, Germany; Sponsored by American Society of Mechanical Engineers, USA
Contract(s)/Grant(s): RTOP 522-70-03; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A probabilistic approach is described for aeropropulsion system assessment. to demonstrate this approach, the technical performance of a wave rotor-enhanced gas turbine engine (i.e. engine net thrust, specific fuel consumption, and engine weight) is assessed. The assessment accounts for the uncertainties in component efficiencies/flows and mechanical design variables, using probability distributions. The results are presented in the form of cumulative distribution functions (CDFS) and sensitivity analyses, and are compared with those from the traditional deterministic approach. The comparison shows that the probabilistic approach provides a more realistic and systematic way to assess an aeropropulsion system.
Author
Distribution Functions; Gas Turbine Engines; Probability Theory; Wave Rotors; Mechanical Engineering; Propulsion System Performance

20000069028 Department of Defense, Office of the Inspector General, Arlington, VA USA
Procurement of Secondary Exhaust Seal and Secondary Exhaust Flap for the F404 Engine
Apr. 21, 1993; 14p; In English
Report No.(s): AD-A376806; IG/DOD-93-088; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We are providing this final report for your information and use. The audit was in response to a DoD Hotline complaint received during our audit of the procurement of spare parts and supplies (Project No. OCH-5017). The complainant alleged that the Navy Aviation Supply Office (ASO) was avoiding competition by using an Air Force basic ordering agreement (BOA) to procure secondary exhaust seals and secondary exhaust flaps for the F4O4 engine and paying higher prices than if the procurements were competitive. The audit objectives were to determine whether ASO followed Federal and DoD acquisition regulations when procuring the secondary exhaust seal and flap, and to examine applicable internal control. We concluded that ASO followed appropriate acquisition regulations. ASO used an Air Force BOA with General Electric Aircraft Engines and competitive contracts with other sources to procure the parts. The noncompetitive procurements using the Air Force BOA were properly justified and approved. However, the prices on the noncompetitive procurements were higher than the prices on the competitive procurements. The differences in the prices paid clearly show the monetary benefits of competitive purchases of the parts.
DTIC

Seals (Stoppers); Aircraft Engines; Flapping; Flaps (Control Surfaces)

20000069804 Office of Naval Research, Mechanics and Energy Conversion S and T Div., Arlington, VA USA

Challenges and Opportunities in the Development of Pulse Detonation Engines

Roy, Gabriel D., Office of Naval Research, USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 15-23; In English; See also 20000069802; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

As longer range and fuel economy are desired of propulsion systems, research has been focused on various avenues such as energetic fuels and combustion control. Propulsion engines based on the pulse detonation cycle offer the potential of higher thermodynamic cycle efficiency, better specific thrust and reduced fuel consumption. In some cases this can be achieved with no moving parts. The simplicity of the air breathing Pulse Detonation Engine (PDE) and its potential for easier scaling extrapolates to substantial reductions in development time, when compared to conventional turbine engines. Multi-cycle, multitube detonation engines offer the potential of fluidic thrust vectoring, with low drag, and without external fins, a decisive advantage in high-speed missile propulsion. Though there is extensive literature on detonations, not much research has been undertaken to address the challenging scientific issues involved in utilizing this concept for propulsion. A number of opportunities exists for the analysts, computationalists, and experimentalists. The Office of Naval Research (ONR) initiated a five-year core research and a Multidisciplinary University Research Initiative (MURI) program in PDE for propulsion applications. The various challenges in the research and development of PDE for propulsion applications, the opportunities that arise in this pursuit, and the approach taken to enable this technology as a viable option for propulsion engines are addressed in this paper.
Author

Air Breathing Engines; Combustion Control; Detonation; Fuel Consumption; Propulsion System Performance; Pulsed Jet Engines

20000069807 National Academy of Sciences - National Research Council, Hampton, VA USA

Numerical Simulation of Dual-Mode Scramjet Combustors

Rodriguez, C. G., National Academy of Sciences - National Research Council, USA; Riggins, D. W., Tennessee Univ., USA; Bittner, R. D., FDC/NYMA, Inc., USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 47-64; In English; See also 20000069802; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

Results of a numerical investigation of a three-dimensional dual-mode scramjet isolator-combustor flow field are presented. Specifically, the effect of wall cooling on upstream interaction and flow structure is examined for a case assuming jet-to-jet symmetry within the combustor. Comparisons are made with available experimental wall pressures. The half duct for the isolator-combustor is then modeled in order to study the influence of side walls. Large scale three-dimensionality is observed in the flow with massive separation forward on the side walls of the duct. A brief review of convergence acceleration techniques useful in dual-mode simulations is presented, followed by recommendations regarding the development of a reliable and unambiguous experimental data base for guiding CFD code assessments in this area.
Author

Combustion Chambers; Computational Fluid Dynamics; Computerized Simulation; Three Dimensional Flow; Mathematical Models; Supersonic Combustion Ramjet Engines

20000069811 NASA Ames Research Center, Moffett Field, CA USA

Theoretical Performance of Frictionless MHD-Bypass Scramjets

Park, Chul, Thermoscience Inst., USA; Bogdanoff, David, Thermoscience Inst., USA; Mehta, Unmeel B., NASA Ames Research

Center, USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 103-120; In English; See also 20000069802; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

Theoretical performance calculation is made of a scramjet propulsion system incorporating a magneto-hydro-dynamic (MHD) energy bypass scheme. The MHD generator upstream of the combustion chamber slows down the flow so that the mach number at the entrance of the combustion chamber is kept below a specified value. The MHD accelerator downstream of the combustion chamber accelerates the flow, expending the electrical power produced by the generator. The flow is seeded with potassium or cesium, and the MHD devices operate as Faraday machines. Friction is neglected, and chemical equilibrium is assumed everywhere except in the nozzle downstream of the freezing point. The calculation shows that the MHD-bypass scheme can improve specific impulse over that of a conventional scramjet at flight speeds over 3.5 kilometers per second. At speeds below about 6 km/s, the calculated specific impulse can be higher than that of a typical rocket engine. Consequently, the MHD-bypass scheme can extend the operational range or improve the performance of a conventional scramjet engine.
Author

Bypasses; Combustion Chambers; Magnetohydrodynamic Generators; Supersonic Combustion Ramjet Engines; Mathematical Models; Propulsion System Performance; Friction

20000069813 Naval Research Lab., Lab. for Computational Physics and Fluid Dynamics, Washington, DC USA

Pulsed Detonation Engines: What is Its Performance?

Kailasanath, K., Naval Research Lab., USA; Patnaik, G., Naval Research Lab., USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 131-140; In English; See also 20000069802; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

A review of various computational studies of pulsed detonation engines shows a wide variation in the predicted performance of even an idealized system. Detailed numerical simulations are used to explore some plausible reasons for the observed differences. Simulations with several boundary conditions clearly show that the specific choice of the boundary conditions affects not only the details of the flow field but also the overall performance estimates. The initial conditions used in the simulations to initiate detonations can also significantly add to the performance estimates. The results from these studies are used to reconcile previous performance estimates.
Author

Detonation; Performance Prediction; Computerized Simulation; Rocket Engines; Computation; Pulsed Jet Engines

20000069814 Pennsylvania State Univ., Propulsion Engineering Research Center, University Park, PA USA

Multidisciplinary Study of Pulse Detonation Engine Propulsion

Santoro, R. J., Pennsylvania State Univ., USA; Broda, J. C., Pennsylvania State Univ., USA; Conrad, C., Pennsylvania State Univ., USA; Woodward, R., Pennsylvania State Univ., USA; Pal, S., Pennsylvania State Univ., USA; Lee, S.–Y., Pennsylvania State Univ., USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 141-150; In English; See also 20000069802

Contract(s)/Grant(s): N0014-99-1-0744; F33615-97-D-2768; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

A series of detonation experiments with ethylene/air/O2 mixtures was conducted as part of an extensive research program on air-breathing Pulse Detonation Engines (PDE's). to date, efforts have focused on the initiation and propagation of normal detonations in a 1.34-inch I.D. circular pre-detonator. Initially, single-shot experiments were carried out to obtain the required knowledge and understanding on the Deflagration to Detonation Transition (DDT) process. With the help of carefully designed obstacles, DDT was promoted in ethylene/air mixtures within two feet and in less than 3.5 ms. Based on this achievement, successful multi-cycle operation with ethylene/air and ethylene/(O2+2N2) mixtures was accomplished at frequencies reaching 8-10 Hz and 15-20 Hz respectively. The limitation with respect to the maximum operating frequencies was a result of the poor performance of the fuel solenoid valve, which is not designed to operate at the low supply pressures currently used. Minor changes in the setup should eliminate this problem and it is expected that significantly higher frequencies will be reached in the near future.
Author

Air Breathing Engines; Detonation; Deflagration; Propulsion System Performance; Pulsed Jet Engines

20000069816 Advanced Projects Research, Inc., LaVerne, CA USA

Performance and Thermal Modeling of a Combined Cycle PDE/Ramjet

Moore, K. C., Advanced Projects Research, Inc., USA; Sobota, T. H., Advanced Projects Research, Inc., USA; Sterling, J. D., Advanced Projects Research, Inc., USA; Hagseth, P. E., Lockheed Martin Tactical Aircraft Systems, USA; JANNAF 24th

Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 163-174; In English; See also 20000069802
Contract(s)/Grant(s): NAS3-99006; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

The use of a combined cycle Pulse Detonation Engine/ramjet (PDE/ramjet) for the low-speed propulsion system in a high-speed flight vehicle is considered. The described effort consisted of extending available performance and design tools, configuring a combined cycle PDE/ramjet to meet mission requirements and predicting engine and vehicle level performance. Based on trajectory information from prior high-speed vehicle design, PDE and ramjet flaw area requirements were determined for a designated flight trajectory using PDE and ramjet performance prediction tools. Based on these requirements a combined cycle engine was configured and operating conditions were defined to meet the thrust requirement over the complete mission trajectory. Installed performance of the complete combined cycle engine from inlet to nozzle is discussed. An assessment of cooling requirements as related to the available fuel heat sink was made. Emphasis in thermal analysis was placed on cooling of the PDE.
Author
Rocket-Based Combined-Cycle Engines; Detonation; Performance Prediction; Thermal Analysis; Mathematical Models; Design Analysis; Pulsed Jet Engines; Ramjet Engines

20000069818 Software and Engineering Associates, Inc., Carson City, NV USA
A Simple Theoretical Maximum Performance Model for Pulsed Detonation Engines
Coats, D. E., Software and Engineering Associates, Inc., USA; Dunn, S. S., Software and Engineering Associates, Inc., USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 203-210; In English; See also 20000069802; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

Various models are available for predicting the performance of pulsed detonation engines (PDE's). The range of performance predicted by these models is large. Hence we propose a simple model based on the assumption of a Chapman-Jouguet detonation wave in chemical equilibrium. Additionally we assume that there are no losses within the system. This model should predict the maximum theoretical performance of such devices. The pulsed detonation engine calculation starts with a constant area tube (with or without a nozzle extension) filled with a uniform mixture of fuel and oxidizer at constant pressure. A Chapman-Jouguet detonation is assumed to start at the closed end of the tube and propagate towards the open end. A Method of Characteristics solution calculates the motion of both the detonation and rarefaction waves within the tube. The application of the outflow boundary condition outside of the PDE device treats the interaction of the detonation wave and the external atmosphere. The performance of the PDE is calculated by computing the pressure force on the closed end of the tube plus the nozzle extension until the pressure falls below an input criterion. The specific impulse is calculated from the total impulse and the mass of the fuel and oxidizer initially in the PDE.
Author
Detonation; Detonation Waves; Mathematical Models; Pulsed Jet Engines; Performance Prediction

08
AIRCRAFT STABILITY AND CONTROL

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots.

20000058100 McDonnell-Douglas Aerospace, Long Beach, CA USA
Reference H Cycle 3 Stability, Control, and Flying Qualities Batch Assessments
Henderson, Dennis, McDonnell-Douglas Aerospace, USA; 1997 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 441-476; In English; See also 20000058091; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This work is an update of the assessment completed in February of 1996, when a preliminary assessment report was issued for the Cycle 2B simulation model. The primary purpose of the final assessment was to re-evaluate each assessment against the flight control system (FCS) requirements document using the updated model. Only a limited number of final assessments were completed due to the close proximity of the release of the Langley model and the assessment deliverable date. The assessment used the nonlinear Cycle 3 simulation model because it combines nonlinear aeroelastic (quasi-static) aerodynamic with hinge moment and rate limited control surface deflections. Both Configuration Aerodynamics (Task 32) and Flight Controls (Task 36) were funded in 1996 to conduct the final stability and control assessments of the unaugmented Reference H configuration in FY96.

Because the two tasks had similar output requirements, the work was divided such that Flight Controls would be responsible for the implementation and checkout of the simulation model and Configuration Aerodynamics for writing Matlab "script" files, conducting the batch assessments and writing the assessment report. Additionally, Flight Controls was to investigate control surface allocations schemes different from the baseline Reference H in an effort to fulfill flying qualities criteria.
Derived from text
Flight Control; Control Stability; Technology Assessment; Civil Aviation; Flight Characteristics; Wind Tunnel Tests

20000059221 Virginia Univ., Dept. of Engineering Science and Systems, Charlottesville, VA USA
Application of Active Controls Technology to Aircraft Ride Smoothing Systems
Lapins, Maris, Virginia Univ., USA; Jacobson, Ira D., Virginia Univ., USA; May 1975; 207p; In English
Contract(s)/Grant(s): NGR-47-005-202
Report No.(s): ESS-4039-104-75; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

A critical review of past efforts in the design and testing of ride smoothing and gust alleviation systems is presented. Design trade-offs involving sensor types, choice of feedback loops, human comfort and aircraft handling-qualities criteria are discussed. Synthesis of a system designed to employ direct-lift and side-force producing surfaces is reported. Two STOL-class aircraft and an executive transport are considered. Theoretically-predicted system performance is compared with hybrid simulation and flight test data. Pilot opinion rating, pilot workload, and passenger comfort rating data for the basic and augmented aircraft are included.
Author
Design Analysis; Active Control; Computerized Simulation; Aircraft Control; Smoothing; Flight Simulation; Flight Characteristics

20000064689 NASA Marshall Space Flight Center, Huntsville, AL USA
X-33 Ascent Flight Controller Design by Trajectory Linearization: A Singular Perturbational Approach
Zhu, J. Jim, Louisiana State Univ., USA; Banker, Brad D., Louisiana State Univ., USA; Hall, Charles E., NASA Marshall Space Flight Center, USA; [2000]; 7p; In English; Guidance, Control and Dynamics, 2000, Reston, VA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche

The flight control of X-33 poses a challenge to conventional gain-scheduled flight controllers due to its large attitude maneuvers from liftoff to orbit and reentry. In addition, a wide range of uncertainties in vehicle handling qualities and disturbances must be accommodated by the attitude control system. Nonlinear tracking and decoupling control by trajectory linearization can be viewed as the ideal gain-scheduling controller designed at every point on the flight trajectory. Therefore it provides robust stability and performance at all stages of flight without interpolation of controller gains and eliminates costly controller redesigns due to minor airframe alteration or mission reconfiguration. In this paper, a prototype trajectory linearization design for an X-33 ascent flight controller is presented along with 3-DOF and 6-DOF simulation results. It is noted that the 6-DOF results were obtained from the 3-DOF design with only a few hours of tuning, which demonstrates the inherent robustness of the design technique. It is this "plug-and-play" feature that is much needed by NASA for the development, test and routine operations of the RLV'S. Plans for further research are also presented, and refined 6-DOF simulation results will be presented in the final version of the paper.
Author
Approach Control; Attitude Control; Controllability; Flight Control; Prototypes; Simulation; X-33 Reusable Launch Vehicle

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems.

20000058170 NASA Langley Research Center, Hampton, VA USA
Test Capabilities and Recent Experiences in the NASA Langley 8-Foot High Temperature Tunnel
Hodge, Jeffrey S., NASA Langley Research Center, USA; Harvin, Stephen F., NASA Langley Research Center, USA; [2000]; 14p; In English; Advanced Measurement Technology and Ground Testing, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-2646; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The NASA Langley 8-Foot High Temperature Tunnel is a combustion-heated hypersonic blowdown-to-atmosphere wind tunnel that provides flight enthalpy simulation for Mach numbers of 4, 5, and 7 through an altitude range from 50,000 to 120,000

feet. The open-.jet test section is 8-ft. in diameter and 12-ft. long. The test section will accommodate large air-breathing hypersonic propulsion systems as well as structural and thermal protection system components. Stable wind tunnel test conditions can be provided for 60 seconds. Additional test capabilities are provided by a radiant heater system used to simulate ascent or entry heating profiles. The test medium is the combustion products of air and methane that are burned in a pressurized combustion chamber. Oxygen is added to the test medium for air-breathing propulsion tests so that the test gas contains 21 percent molar oxygen. The facility was modified extensively in the late 1980's to provide airbreathing propulsion testing capability. In this paper, a brief history and general description of the facility are presented along with a discussion of the types of supported testing. Recently completed tests are discussed to explain the capabilities this facility provides and to demonstrate the experience of the staff.
Author
Wind Tunnel Tests; Blowdown Wind Tunnels; Propulsion System Performance; Flight Simulation; Aerodynamic Heating

20000060821 NASA Langley Research Center, Hampton, VA USA
Implementation of the WICS Wall Interference Correction System at the National Transonic Facility
Iyer, Venkit, Lockheed Martin Corp., USA; Everhart, Joel L., NASA Langley Research Center, USA; Bir, Pamela J., Vigyan Research Associates, Inc., USA; Ulbrich, Norbert, Sverdrup Technology, Inc., USA; [2000]; 26p; In English; 21st; Measurement Technology and Ground Testing, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS1-96014
Report No.(s): AIAA Paper 2000-2383; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Wall Interference Correction System (WICS) is operational at the National Transonic Facility (NTF) of NASA Langley Research Center (NASA LaRC) for semispan and full span tests in the solid wall (slots covered) configuration. The method is based on the wall pressure signature method for computing corrections to the measured parameters. It is an adaptation of the WICS code operational at the 12 ft pressure wind tunnel (12ft PWT) of NASA Ames Research Center (NASA ARC). This paper discusses the details of implementation of WICS at the NTF including tunnel calibration, code modifications for tunnel and support geometry, changes made for the NTF wall orifices layout, details of interfacing with the tunnel data processing system, and post-processing of results. Example results of applying WICS to a semispan test and a full span test are presented. Comparison with classical correction results and an analysis of uncertainty in the corrections are also given. As a special application of the code, the Mach number calibration data from a centerline pipe test was computed by WICS. Finally, future work for expanding the applicability of the code including online implementation is discussed.
Author
Aerodynamic Interference; Correction; Wind Tunnel Walls; Research Facilities

20000061489 NASA Langley Research Center, Hampton, VA USA
Simultaneous Global Pressure and Temperature Measurement Technique for Hypersonic Wind Tunnels
Buck, Gregory M., NASA Langley Research Center, USA; [2000]; 14p; In English; 21st; Aerodynamic Measurement Technology and Ground Testing, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-2649; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

High-temperature luminescent coatings are being developed and applied for simultaneous pressure and temperature mapping in conventional-type hypersonic wind tunnels, providing global pressure as well as Global aeroheating measurements. Together, with advanced model fabrication and analysis methods, these techniques will provide a more rapid and complete experimental aerodynamic and aerothermodynamic database for future aerospace vehicles. The current status in development of simultaneous pressure- and temperature-sensitive coatings and measurement techniques for hypersonic wind tunnels at Langley Research Center is described. and initial results from a feasibility study in the Langley 31-Inch Mach 10 Tunnel are presented.
Author
Pressure Measurement; Temperature Measurement; Aerodynamic Heating

20000062013 NASA Langley Research Center, Hampton, VA USA
Overview of Selected Measurement Techniques for Aerodynamics Testing in the NASA Langley Unitary Plan Wind Tunnel
Erickson, Gary E., NASA Langley Research Center, USA; [2000]; 56p; In English; Fluids, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2000-2396; Copyright Waived; Avail: CASI; A04, Hardcopy; A01, Microfiche

An overview is given of selected measurement techniques used in the NASA Langley Research Center (LaRC) Unitary Plan Wind Tunnel (UPWT) to determine the aerodynamic characteristics of aerospace vehicles operating at supersonic speeds. A broad definition of a measurement technique is adopted in this paper and is any qualitative or quantitative experimental approach that provides information leading to the improved understanding of the supersonic aerodynamic characteristics. On-surface and off-surface measurement techniques used to obtain discrete (point) and global (field) measurements and planar and global flow visualizations are described, and examples of all methods are included. The discussion is limited to recent experiences in the UPWT and is, therefore, not an exhaustive review of existing experimental techniques. The diversity and high quality of the measurement techniques and the resultant data illustrate the capabilities of a ground-based experimental facility and the key role that it plays in the advancement of our understanding, prediction, and control of supersonic aerodynamics.
Author
Aerodynamic Characteristics; Aerospace Vehicles; Wind Tunnel Tests; Procedures; Measuring Instruments

20000063473 Defence Science and Technology Organisation, Air Operations Div., Melbourne, Australia
Calibration of the Reference Velocity in the Test Section of the Low Speed Wind Tunnel at the Aeronautical and Maritime Research Laboratory
Edwards, Craig D., Defence Science and Technology Organisation, Australia; February 2000; 46p; In English
Report No.(s): DSTO-TN-0248; AR-011-214; Copyright; Avail: Issuing Activity

The measurement of wind velocity in the test section of the Low Speed Wind Tunnel is obtained from the measurement of dynamic pressure using two piezometer rings located at the entrance and exit of the tunnel contraction. Following the recent installation of a new contraction, a calibration of the dynamic pressure measurement system was performed to determine a new wind tunnel "calibration" factor. This factor is applied as a correction to the pressure measurements obtained from the two piezometer rings to represent accurately the correct dynamic pressure and consequently, velocity, at the centre of the test section midway between the centres of the turntables in the floor and ceiling. A sub-standard pitot-static probe was used to acquire pressure data at various positions within the wind tunnel test section for a range of velocities. The new tunnel calibration factor, representative of all wind speeds, was determined to be 1.079, an increase of 3.3% over the factor of 1.045 for the previous contraction. This report contains all of the test data and a detailed account of the procedure and equipment used to derive this new calibration factor.
Author
Calibrating; Wind Velocity Measurement; Dynamic Pressure; Low Speed Wind Tunnels

20000064101 Institute for Human Factors TNO, Soesterberg, Netherlands
Specification and Evaluation of the Functional Requirements of a UAV Crew Trainer ***Final Report***
Helsdingen, A. S., Institute for Human Factors TNO, Netherlands; Aug. 12, 1999; 52p; In English
Contract(s)/Grant(s): A96/CO/363; TNO Proj. 730.3
Report No.(s): TD-99-0332; TM-99-A055; Copyright; Avail: Issuing Activity

To investigate the possibilities for application of low-cost simulators within military training courses, the research project called ELSTAR (European Low-cost Simulation technology for the ARmed forces) is carried out under the contract of the Ministries of Defence of the five participating countries of Research Technology Project (RTP) 11.8, viz. Belgium, France, Germany, Greece, and The Netherlands. This project consists of 5 work packages. In the current work package 3 of the ELSTAR project, an elaborate investigation of the task- and training requirements of the selected training areas, must render more detailed descriptions of four selected training systems. The current report includes a task- and training analysis of a Unmanned Aerial Vehicle (UAV) crew, which formed the basis for the functional requirements of a UAV crew trainer. In order to determine low-cost solutions for this trainer, the cost driving requirements of the system were identified. The effects of degrading these requirements on the training value of the UAV crew trainer were evaluated in a experimental study. The results of the task and training analyses show that visual information is the most important source of information for the UAV crew to perform its tasks; therefore, the focus of the functional specifications is on the image system, with its image generator, display system, and visual database. In the development of a UAV simulator, it seems that the visual database is the major factor in the costs. This database needs to be large and very detailed, which causes the development to be time- consuming and expensive. In the evaluation study two degraded database configurations were tested: both configurations involve the definition of a high detail target area within the database, while the surrounding area is either left out or displayed with a lower level of detail. The results show that the UAV experts evaluated both simulator configurations as having a high training value. Nevertheless, their additional remarks show that they see room for improvement. This evaluation experiment can be seen as a first attempt to define the value of specific configuration of

subsystems of the simulator for training. In a later stage of this project, training value will be determined by objective measurements against alternative training methods.
Author
Data Bases; Display Devices; Education; Functional Design Specifications; Pilotless Aircraft; Research and Development; Systems Simulation; Training Simulators

20000064113 DYNACS Engineering Co., Inc., Brook Park, OH USA
Subsonic Calibration of the NASA Glenn Research Center 10- by 10-Foot Supersonic Wind Tunnel (1998 Tests)
Arrington, E. Allen, DYNACS Engineering Co., Inc., USA; Gonsalez, Jose C., DYNACS Engineering Co., Inc., USA; Curry, Monroe R., III, DYNACS Engineering Co., Inc., USA; [2000]; 26p; In English; 21st; Aerodynamic Measurement Technology and Ground Testing, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-2448; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Safe and efficient subsonic operation of the NASA Glenn Research Center 10- by 10-Foot Supersonic Wind Tunnel (10x10 SWT) was demonstrated in April 1996, at which time limited test section flow quality data were collected. Those data showed that the subsonic operating conditions were acceptable in terms of pressure and Mach number distribution, and it was recommended that more complete documentation of the subsonic operating regime be compiled. Calibration and flow quality surveys were conducted in the test section of the 10x10 SWT to fully document the subsonic capabilities of the facility. This report describes the testing, data analysis and results from the calibration and flow quality surveys.
Author
Supersonic Wind Tunnels; Calibrating; Test Chambers

20000069805 NASA Langley Research Center, Hampton, VA USA
Test Capabilities and Recent Experiences in the NASA Langley 8-Foot High Temperature Tunnel
Hodge, J. S., NASA Langley Research Center, USA; Harvin, S. F., NASA Langley Research Center, USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 25-36; In English; See also 20000069802; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

The NASA Langley 8-Foot High Temperature Tunnel (8-Ft. HTT) is a combustion-heated hypersonic blowdown-to-atmosphere wind tunnel that provides flight enthalpy simulation for Mach numbers of 4, 5, and 7 through an altitude range from 50,000 to 120,000 feet. The open-jet test section is 8-ft. in diameter and 12-ft. long. The test section will accommodate large air-breathing hypersonic propulsion systems as well as structural and thermal protection system (TPS) components. Stable wind tunnel test conditions can be provided for a duration of 60 seconds. Additional test capabilities are provided by a radiant heater system that can be used to simulate ascent or entry heating profiles. The test medium is the combustion products of air and methane that are burned in a pressurized combustion chamber. Oxygen is added to the test medium for air-breathing propulsion tests so that the test gas contains twenty one percent molar oxygen. The facility was modified extensively in the late 1980's to provide airbreathing propulsion testing capability. In this paper, a brief history and general description of the facility are presented along with a discussion of the types of testing that can be supported. Recently completed tests conducted in the 8-Ft. HTT are discussed to explain the capabilities the facility provides and to demonstrate the experience of the staff.
Author
High Temperature; Hypersonics; Wind Tunnel Tests; Aerodynamic Heating; Air Breathing Engines; Blowdown Wind Tunnels

20000069835 Air Force Research Lab., Human Effectiveness Directorate, Mesa, AZ USA
Portable Eye-Tracking System Used During F-16 Simulator Training Missions at Luke AFB: Adjustment and Calibration Procedures *Final Report, Apr. 1997 - Sep. 1998*
Wetzel, Pual A.; Anderson, Gretchen; Nov. 1998; 25p; In English; Prepared in cooperation with Raytheon Training Systems
Contract(s)/Grant(s): F41624-97-D-5000; AF Proj. 1123
Report No.(s): AD-A368304; AFRL-HE-AZ-TP-1998-0111; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

A portable eye-tracking system has been employed at Luke Air Force Base, AZ, for use during F-16 B-course simulator training missions. Proper headband adjustment and accurate calibration of the eye-tracking system allows the instructor to see exactly where the student is looking throughout the training mission. This paper describes the components of; and the correct adjustment procedures for, the Elmar Vision 2000 system. These procedures were developed in order to allow the system to successfully be transitioned to the user; namely, the simulator operator.
DTIC
Training Simulators; Flight Training; Flight Simulation; Tracking (Position)

20000069852 Army Research Lab., Sensors Directorate, Adelphi, MD USA
Design and Test of a Prototype Acoustic High-Intensity Infrasonic Test Chamber
Boesch, H. E., Jr.; Benwell, Bruce T.; Reiff, Christian G.; Apr. 2000; 38p; In English
Contract(s)/Grant(s): Proj-A140
Report No.(s): AD-A377759; ARL-TR-2137; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We describe the conception, design, mathematical modeling, construction, and test of a prototype acoustic test chamber intended to support the performance of high-intensity acoustic target-effects experiments on large targets at infrasonic frequencies. In initial experiments, the test chamber produced continuous sinusoidal sound pressure levels in excess of 140 dB over a frequency range of 5 to 20 Hz within a test volume of 5 cubic m.

DTIC
Structural Design; Test Chambers

10
ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms.

20000058142 NASA Kennedy Space Center, Cocoa Beach, FL USA
Atlas GEOS-J Pad Activity with Blockhouse
May 19, 1995; In English; Videotape: 4 min. 32 sec. playing time, in color, without sound
Report No.(s): NONP-NASA-VT-2000078626; KSC95-50586; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Footage shows night shots of the erected Atlas GEOS-J on the launch pad, and work being done.

CASI
Launching Pads; Preflight Operations; Flight Operations; Aircraft Maintenance

20000063490 NASA Kennedy Space Center, Cocoa Beach, FL USA
AC 67 Launch Video
Mar. 26, 1987; In English; Videotape: 2 min. 4 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000078612; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Live footage of the Unmanned Atlas Centaur (AC) 67 launch is presented on March 26, 1987 at the WESH television station in Florida. Lightning is shown after 49 seconds into the flight. The vehicle is totally destroyed due to a cloud-to-ground lightning flash.

CASI
Pilotless Aircraft; Atlas Centaur Launch Vehicle; Liftoff (Launching)

20000068530 NASA, Washington, DC USA
Hypersonics Before the Shuttle: A Concise History of the X-15 Research Airplane
Jenkins, Dennis R., NASA, USA; June 2000; 132p; In English
Report No.(s): NASA/SP-2000-4518; NAS 1.21:4518; LC-00-038683; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

It is a beginning. Over forty-five years have elapsed since the X-15 was conceived; 40 since it first flew. and 31 since the program ended. Although it is usually heralded as the most productive flight research program ever undertaken, no serious history has been assembled to capture its design, development, operations, and lessons. This monograph is the first step towards that history. Not that a great deal not previously been written about the X-15, because it has. But most of it has been limited to specific aspects of the program; pilot's stories, experiments. lessons-learned, etc. But with the exception of Robert S. Houston's history published by the Wright Air Development Center in 1958, and later included in the Air Force History Office's Hypersonic Revolution, no one has attempted to tell the entire story. and the WADC history is taken entirely from the Air Force perspective, with small mention of the other contributors.

Derived from text
Hypersonics; Research Aircraft; Histories; X-15 Aircraft; Aircraft Design

20000058149 NASA Kennedy Space Center, Cocoa Beach, FL USA

XTE Delta 2nd Stage Erection at Complex 17A, Cape Canaveral Air Station

Jul. 28, 1995; In English; Videotape: 4 min. 30 sec. playing time, in color, without sound

Report No.(s): NONP-NASA-VT-2000078592; KSC95-50833; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Footage shows the erection of the Delta 2nd Stage vehicle at launch pad 17A. Scenes include the lifting of the component onto the launch pad.

CASI

Construction; Aircraft Maintenance; Flight Operations; Preflight Operations

20000064622 Virginia Polytechnic Inst. and State Univ., Multidisciplinary Analysis and Design (MAD) Center for Advanced Vehicles, Blacksburg, VA USA

Study of a Global Design Space Exploration Method for Aerospace Vehicles

Baker, Chuck A., Virginia Polytechnic Inst. and State Univ., USA; Watson, Layne T., Virginia Polytechnic Inst. and State Univ., USA; Grossman, Bernard, Virginia Polytechnic Inst. and State Univ., USA; Mason, William H., Virginia Polytechnic Inst. and State Univ., USA; Cox, Steven E., Florida Univ., USA; Haftka, Raphael T., Florida Univ., USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In the early stages of the design process of aerospace vehicles, the search for optimal configurations is wide open, and the use of local optimization tools may risk missing the best designs. Therefore, global optimization methods are attractive for the early design stage. Unfortunately, global design optimization usually requires the evaluation of a very large number of designs, a formidable computational challenge. The present work demonstrates the use of massively parallel computers for handling this computational challenge. A variety of load balancing methods are used to ensure efficient utilization of the computer nodes. Global optimization was applied to the High Speed Civil Transport (HSCT) aerospace configuration design problem with 28 design variables and 68 nonlinear constraints in a multidisciplinary design optimization (MDO) environment. Even with the use of simple engineering analyses, a thorough design space search is computationally expensive due to the large number of designs that need to be evaluated. The more expensive constraints, such as range and takeoff distances, are performance related. Previous work with this design problem has shown that the design space contains disconnected islands of feasible points, representing different available design concepts. These complexities make it difficult for an optimizer to successfully find the global optimum. The global optimization method used is a Lipschitz algorithm that (essentially) uses all possible values of the Lipschitz constant. By using all possible values of the constant, equal emphasis is placed on local and global search by the optimizer. This causes the optimizer to continue searching globally for the islands of feasible space, while converging on designs in the promising regions that have already been discovered. For each optimization cycle in the algorithm, a large set of new designs that need to be evaluated is generated. Since the objective function and constraint evaluations for each design can be computed independently, parallel computers can be easily used to concurrently evaluate all of the new designs. When there is enough variance in the evaluation time of these designs it is beneficial to have some form of dynamic load balancing. The load balancing schemes investigated for this study are: static load balancing, dynamic load balancing with a master-slave processor organization, fully distributed dynamic load balancing, and fully distributed dynamic load balancing via threads. The parallel optimization runs were conducted for a fixed number of iterations of the modified Lipschitzian algorithm on an SGI Origin 2000. Around 10,000 aircraft designs were evaluated in the design space exploration before finding the global optimum, with the optimizer sampling many of the promising regions of the design space in the process. The variation in the evaluation times of the designs investigated was small. The parallel efficiencies for runs with up to 64 processors are shown. It can be seen that when using a small number of processors, the fully distributed version of the code with dynamic load balancing outperforms the other methods of load balancing for the HSCT problem. However, as the number of processors increase, the static load balancing and hierarchical dynamic load balancing are the most efficient. The reason for this behavior is that with fewer processors the number of tasks per processor is increased and differences in evaluation time are magnified, making the problem better suited to dynamic load balancing. With more processors, the processor load imbalance becomes negligible and dynamic load balancing is not needed. For the parallel computer used, the extra overhead in the threaded dynamic load balancing scheme caused its efficiency to decrease more than the schemes without threads as the number of processors was increased. The global optimizer proved to be a useful tool for design space exploration. The optimizer was able to methodically search a high dimensional design space and identify regions of promise containing different design concepts with surprisingly few function evaluations. The sensitivity of load balancing performance to variation in function evaluation time for large MDO problems was also observed. It was seen that when there is a small variation in design evaluation time, the computational overhead needed for dynamic load balancing impeded the parallel performance, and it was

more efficient to use static load balancing. However, when the variation in design evaluation times is sufficiently large, fully distributed versions of the code with dynamic load balancing performed best.
Author
Aircraft Design; Design Analysis; Massively Parallel Processors; Multidisciplinary Design Optimization; Parallel Processing (Computers)

20000067668 NASA Kennedy Space Center, Cocoa Beach, FL USA
Pegasus Departs from KSC
Feb. 09, 1993; In English; Videotape: 2 min. 32 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000081536; KSC93-30261; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS
Footage shows the departure of the Pegasus launch vehicle from Kennedy Space Center (KSC).
CASI
Pegasus Air-Launched Booster; Air Launching; B-52 Aircraft

20000070492 NASA Kennedy Space Center, Cocoa Beach, FL USA
AC-67 Press Conference
Mar. 26, 1987; In English; Videotape: 29 min., 05 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000078609; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS
On March 26, 1987, after the launch of an Atlas/Centaur rocket with a payload of a Navy Communications Satellite, a problem developed and the rocket was lost. This videotape is a press conference held to review the incident. Mr. John Gibb, the Atlas-Centaur Program Manager at Lewis Research Center, opens the press conference with a statement that reviews the situation, and what is known about the accident. He reviews the constraints to launch and explains that to the best of his knowledge there was no violation of these constraints. He further states that a review panel will investigate the circumstances and make recommendations. The press conference is then opened up to questions. Most of the questions concern the weather conditions and the existence of lightning in the area. The Air Force representative, Colonel John Albrook, is asked if the loss of the satellite would pose any problems. He answers that there were several satellites performing the role for which this satellite was slated, and that these were still healthy, and capable of continuing for a considerable length of time.
CASI
Lightning; Weather; Flight Hazards; Meteorological Parameters; Liftoff (Launching)

11
CHEMISTRY AND MATERIALS (GENERAL)

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft.

20000065632 NASA Marshall Space Flight Center, Huntsville, AL USA
Parallel Processing in Combustion Analysis
Schunk, Richard Gregory, NASA Marshall Space Flight Center, USA; Chung, T. J., Alabama Univ., USA; Apr. 26, 2000; 19p; In English; Finite Elements in Flow Problems, 30 Apr. - 4 May 2000, Austin, TX, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The objective of this research is to demonstrate the application of the Flow-field Dependent Variation (FDV) method to a problem of current interest in supersonic chemical combustion. Due in part to the stiffness of the chemical reactions, the solution of such problems on unstructured three dimensional grids often dictates the use of parallel computers. Preliminary results for the injection of a supersonic hydrogen stream into vitiated air are presented.
Derived from text
Flow Distribution; Parallel Processing (Computers); Supersonic Combustion; Parallel Computers

20000069802 Johns Hopkins Univ., Chemical Propulsion Information Agency, Columbia, MD USA
JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting, Volume 1, *11 Dec. 1998 - 18 Oct. 1999*
Fry, Ronald S., Editor, Johns Hopkins Univ., USA; Gannaway, Mary T., Editor, Johns Hopkins Univ., USA; October 1999; 232p; In English; 24th; 36th; Airbreathing Propulsion, 18-21 Oct. 1999, Cocoa Beach, FL, Cocoa Beach, FL, USA, USA; Sponsored

by NASA, USA; See also 20000069803 through 20000069818
Contract(s)/Grant(s): SPO700-97-D-4004
Report No.(s): CPIA-Publ-692-Vol-1; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

Volume 1, the first of three volumes is a compilation of 16 unclassified/unlimited-technical papers presented at the Joint Army-Navy-NASA-Air Force (JANNAF) 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee held jointly with the 181 Propulsion Systems Hazards Subcommittee. The meeting was held on 18-21 October 1999 at NASA Kennedy Space Center and The DoubleTree Oceanfront Hotel, Cocoa Beach, Florida. Topics covered include overviews of RBCC and PDE hypersonic technology, Hyper-X propulsion ground testing, development of JP-8 for hypersonic vehicle applications, numerical simulation of dual-mode SJ combustion, V&V of M&S computer codes, MHD SJ and Rocket Based Combined Cycle (RBCC) launch vehicle concepts, and Pulse Detonation Engine (PDE) propulsion technology development including fundamental investigations, modeling, aerodynamics, operation and performance.
Author
Air Breathing Engines; Propulsion System Performance; Computational Fluid Dynamics; Wind Tunnel Tests; Supersonic Combustion

20000069809 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA
Computational and Modeling Constraints for LES of Turbulent Combustion
Menon, S., Georgia Inst. of Tech., USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 73-90; In English; See also 20000069802; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

The next generation gas turbine engine are required to significantly reduce pollutant emission and be also fuel-efficient. Accurate prediction of pollutant formation requires proper resolution of the spatio-temporal evolution of the unsteady mixing and combustion processes. Conventional steady state methods are not able to deal these features. Methodology based on large-eddy simulations (LES) has become a viable method for studying such unsteady reacting flows. However, for LES to be used successfully, careful considerations are required in order to ensure that the methodology is capable of providing reliable data. This implies special constraints on the accuracy of the numerical scheme and on the physics simulated and modeled within the LES model. This paper discusses these issues and then, as an example, describes a new LES methodology developed for both single and two-phase reacting flows that has demonstrated its accuracy by simulating correctly reacting turbulent flows in both laboratory scale and full-scale gas turbine combustors. A key feature of this new solver is the manner in which small-scale turbulent mixing and combustion is simulated. This feature allows proper characterization of the effects of both largescale convection and small-scale mixing on the scalar processes thereby, providing a more accurate prediction of chemical reaction effects. Comparison with experimental data confirm the accuracy of the new simulation too[which is now being used to study spray combustion in full-scale gas turbine combustors.
Author
Combustion Physics; Gas Turbine Engines; Large Eddy Simulation; Computational Fluid Dynamics; Mathematical Models; Turbulent Mixing

20000069866 METSS Corp., Columbus, OH USA
Development and Optimization of Powders for Large Area Powder Coatings *Final Report, 1 Jun. 1996-30 Apr. 1997*
Heater, Kenneth J., METSS Corp., USA; May 1997; 61p; In English
Contract(s)/Grant(s): F33615-94-C-5803; AF Proj. 2422
Report No.(s): AD-A377644; G-96-003-FR; AFRL-ML-WP-TR-2000-4049; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

Technologies with the potential to produce mono-disperse powders for High Velocity Thermal Spray (HVTS) application and pigmented polymer beads for advanced aircraft coatings formulations were evaluated under this program. Conventional spray atomization techniques, including supercritical fluid spray atomization, and REES processing were determined to be ineffectual in meeting the objectives. However, experimental results of supercritical Gas Anti-Solvent (GAS) processing and inkjet production methods demonstrated the potential of each of these technologies to produce the desired products. Additional formulation development and process optimization work will have to be performed before sufficient quantities (10 lbs) of materials can be produced for HVTS testing and evaluation.
DTIC
Powder (Particles); Sprayed Coatings; Aircraft Maintenance; Production Engineering

20000069806 Air Force Research Lab., Wright-Patterson AFB, OH USA
The Development of JP-8 as a Replacement Fuel for JP-TS Jet Fuel
Obringer, C., Air Force Research Lab., USA; Ervin, J. S., Dayton Univ. Research Inst., USA; Zabarnick, S., Dayton Univ. Research Inst., USA; Davis, D., Dayton Univ. Research Inst., USA; Binns, E., Dayton Univ. Research Inst., USA; Dieterle, G., Dayton Univ. Research Inst., USA; JANNAF 24th Airbreathing Propulsion Subcommittee and 36th Combustion Subcommittee Joint Meeting; October 1999; Volume 1, pp. 37-46; In English; See also 20000069802
Contract(s)/Grant(s): F33615-97-C-2719; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

JPTS is a specialty fuel that has excellent thermal-oxidative stability characteristics and a low freeze point temperature. Unfortunately, JPTS costs nearly five times as much as the more readily available JP-8 fuel. In addition, replacement of JPTS with JP-8 has important logistical advantages. Thus, it would be advantageous to have a JP-8 fuel that has thermal-oxidative and low-temperature characteristics that are similar to those of JPTS. The JP-8+100 additive package that has been developed previously provides JP-8 fuels with very low surface deposition characteristics. However, enhancement of the low-temperature behavior of JP-8 has not been addressed. An effort has recently been undertaken to study the feasibility of developing low-temperature additives for JP-8+1 00 fuel. One objective was to experimentally determine if a class of additives commonly used in diesel fuels (cold flow enhancers) could effectively be used in kerosene based fuels. The additives, developed by several additive manufacturers, were blended with a representative JP-8+100 fuel. The additives were evaluated in a low-temperature test facility that was designed to simulate severe conditions (-54 to -57 C) existing within an aircraft fuel wing tank. Both the amount of solidified fuel remaining in the tank after the flowing fuel had been drained (hold-up) and the reduction in fuel flow rate from that at 21 C were measured. We observed significant enhancement of the cold flow characteristics of the fuel by some of the tested additives. These results strongly suggest that an additive can be used to enhance the low-temperature properties of JP-8+1 00 such that it behaves more like JPTS.
Author
Jet Engine Fuels; JP-8 Jet Fuel; Replacing; Additives; Low Temperature

12
ENGINEERING (GENERAL)

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention.

20000058160 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Design Models for the Development of Helium-Carbon Sorption Crycoolers
Lindensmith, C. A., Jet Propulsion Lab., California Inst. of Tech., USA; Ahart, M., Jet Propulsion Lab., California Inst. of Tech., USA; Bhandari, P., Jet Propulsion Lab., California Inst. of Tech., USA; Wade, L. A., Jet Propulsion Lab., California Inst. of Tech., USA; Paine, C. G., Jet Propulsion Lab., California Inst. of Tech., USA; 2000; 6p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We have developed models for predicting the performance of helium-based Joule-Thomson continuous-flow cryocoolers using charcoal-pumped sorption compressors. The models take as inputs the number of compressors, desired heat-lift, cold tip temperature, and available precooling temperature and provide design parameters as outputs. Future laboratory development will be used to verify and improve the models. We will present a preliminary design for a two-stage vibration-free cryocooler that is being proposed as part of a mid-infrared camera on NASA's Next Generation Space Telescope. Model predictions show that a 10 mW helium-carbon cryocooler with a base temperature of 5.5 K will reject less than 650 mW at 18 K. The total input power to the helium-carbon stage is 650 mW. These models, which run in MathCad and Microsoft Excel, can be coupled to similar models for hydrogen sorption coolers to give designs for 2-stage vibration-free cryocoolers that provide cooling from approx. 50 K to 4 K.
Author
Coolers; Cryogenic Cooling; Compressors; Helium; Design Analysis; Mathematical Models; Performance Prediction; Sorption

20000061422 Air Force Research Lab., Wright-Patterson AFB, OH USA
The Multidisciplinary Engineer in the Context of Concurrent Engineering
Moorhouse, David J., Air Force Research Lab., USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 3-1 - 3-7; In English; See also 20000061419; Copyright Waived; Avail: CASI; A02, Hardcopy

Throughout the evolution of the design of flight vehicles, the role of the individual engineer has also evolved. As aircraft have become more complex and performance envelopes have become ever larger, the role of the technical specialist has diminished in favor of the design team approach. Although the theme of the symposium deals with aerodynamic design and optimization, many comments apply to all technical disciplines. In this paper we review this design evolution very briefly. It is suggested that the evolutionary design process led to independent technical disciplines, technology development along the same lines and finally engineering education in the same engineering sciences. Concurrent engineering is discussed, together with the advantages and disadvantages from the viewpoint of the practicing engineers. It is suggested that the required approach leads to a requirement for engineers with a broader view than the traditional specialists. Next we consider the education process which, for design engineers, has evolved from apprenticeship to curricula that teach the engineering sciences. It is suggested that we may need to consider moving to the science of engineering. Finally, a possible view of future aerospace vehicle design is presented.
Author
Aerodynamics; Concurrent Engineering; Engineers; Transfer of Training; Design Analysis

20000060830 NASA Langley Research Center, Hampton, VA USA
Investigation of Electromagnetic Field Threat to Fuel Tank Wiring of a Transport Aircraft
Ely, Jay J., NASA Langley Research Center, USA; Nguyen, Truong X., NASA Langley Research Center, USA; Dudley, Kenneth L., NASA Langley Research Center, USA; Scearce, Stephen A., NASA Langley Research Center, USA; Beck, Fred B., NASA Langley Research Center, USA; Deshpande, Manohar D., NYMA, Inc., USA; Cockrell, C. R., NASA Langley Research Center, USA; March 2000; 204p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 522-14-21-51
Report No.(s): NASA/TP-2000-209867; L-17967; NAS 1.60:209867; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

National Transportation Safety Board investigators have questioned whether an electrical discharge in the Fuel Quantity Indication System (FQIS) may have initiated the TWA-800 center wing tank explosion. Because the FQIS was designed to be incapable of producing such a discharge on its own, attention has been directed to mechanisms of outside electromagnetic influence. to support the investigation, the NASA Langley Research Center was tasked to study the potential for radiated electromagnetic fields from external radio frequency (RF) transmitters and passenger carried portable electronic devices (PEDs) to excite the FQIS enough to cause arcing, sparking or excessive heating within the fuel tank.
Author
Electromagnetic Fields; Explosions; Fuel Systems; Potential Fields; Safety Management; Wing Tanks

20000063376 NASA Glenn Research Center, Cleveland, OH USA
Fuzzy Current-Mode Control and Stability Analysis
Kopasakis, George, NASA Glenn Research Center, USA; June 2000; 18p; In English; 35th; Intersociety Energy Conversion Engineering, 24-28 Jul. 2000, Las Vegas, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 632-70-0A
Report No.(s): NASA/TM-2000-210068; E-12311; NAS 1.15:210068; AIAA Paper 2000-2803; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper a current-mode control (CMC) methodology is developed for a buck converter by using a fuzzy logic controller. Conventional CMC methodologies are based on lead-lag compensation with voltage and inductor current feedback. In this paper the converter lead-lag compensation will be substituted with a fuzzy controller. A small-signal model of the fuzzy controller will also be developed in order to examine the stability properties of this buck converter control system. The paper develops an analytical approach, introducing fuzzy control into the area of CMC.
Author
Fuzzy Systems; Approach Control; Stability Tests; Electric Potential; Controllers

20000060831 NASA Langley Research Center, Hampton, VA USA
High Speed Vortex Flows
Wood, Richard M., NASA Langley Research Center, USA; Wilcox, Floyd J., Jr., NASA Langley Research Center, USA; Bauer, Steven X. S., NASA Langley Research Center, USA; Allen, Jerry M., NASA Langley Research Center, USA; [2000]; 72p; In English; Fluids, 19-22 Jun. 2000, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2000-2215; Copyright Waived; Avail: CASI; A04, Hardcopy; A01, Microfiche

A review of the research conducted at the National Aeronautics and Space Administration (NASA), Langley Research Center (LaRC) into high-speed vortex flows during the 1970s, 1980s, and 1990s is presented. The data reviewed is for flat plates, cavities, bodies, missiles, wings, and aircraft. These data are presented and discussed relative to the design of future vehicles. Also presented is a brief historical review of the extensive body of high-speed vortex flow research from the 1940s to the present in order to provide perspective of the NASA LaRC's high-speed research results. Data are presented which show the types of vortex structures which occur at supersonic speeds and the impact of these flow structures to vehicle performance and control is discussed. The data presented shows the presence of both small- and large scale vortex structures for a variety of vehicles, from missiles to transports. For cavities, the data show very complex multiple vortex structures exist at all combinations of cavity depth to length ratios and Mach number. The data for missiles show the existence of very strong interference effects between body and/or fin vortices and the downstream fins. It was shown that these vortex flow interference effects could be both positive and negative. Data are shown which highlights the effect that leading-edge sweep, leading-edge bluntness, wing thickness, location of maximum thickness, and camber has on the aerodynamics of and flow over delta wings. The observed flow fields for delta wings (i.e. separation bubble, classical vortex, vortex with shock, etc.) are discussed in the context of' aircraft design. and data have been shown that indicate that aerodynamic performance improvements are available by considering vortex flows as a primary design feature. Finally a discussing of a design approach for wings which utilize vortex flows for improved aerodynamic performance at supersonic speed is presented.

Author

High Speed; Vortices; Flow Distribution; Data Acquisition; Leading Edge Sweep; Aerodynamic Characteristics

20000062308 NASA Glenn Research Center, Cleveland, OH USA

Numerical Simulation of Non-Rotating and Rotating Coolant Channel Flow Fields, Part 1

Rigby, David L., NASA Glenn Research Center, USA; [2000]; 26p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Future generations of ultra high bypass-ratio jet engines will require far higher pressure ratios and operating temperatures than those of current engines. For the foreseeable future, engine materials will not be able to withstand the high temperatures without some form of cooling. In particular the turbine blades, which are under high thermal as well as mechanical loads, must be cooled. Cooling of turbine blades is achieved by bleeding air from the compressor stage of the engine through complicated internal passages in the turbine blades (internal cooling, including jet-impingement cooling) and by bleeding small amounts of air into the boundary layer of the external flow through small discrete holes on the surface of the blade (film cooling and transpiration cooling). The cooling must be done using a minimum amount of air or any increases in efficiency gained through higher operating temperature will be lost due to added load on the compressor stage. Turbine cooling schemes have traditionally been based on extensive empirical data bases, quasi-one-dimensional computational fluid dynamics (CFD) analysis, and trial and error. With improved capabilities of CFD, these traditional methods can be augmented by full three-dimensional simulations of the coolant flow to predict in detail the heat transfer and metal temperatures. Several aspects of turbine coolant flows make such application of CFD difficult, thus a highly effective CFD methodology must be used. First, high resolution of the flow field is required to attain the needed accuracy for heat transfer predictions, making highly efficient flow solvers essential for such computations. Second, the geometries of the flow passages are complicated but must be modeled accurately in order to capture all important details of the flow. This makes grid generation and grid quality important issues. Finally, since coolant flows are turbulent and separated the effects of turbulence must be modeled with a low Reynolds number turbulence model to accurately predict details of heat transfer.

Derived from text

Flow Distribution; Rotation; Coolants; Cooling; Jet Engines; Three Dimensional Models

20000063505 Hampton Univ., School of Engineering and Technology, VA USA

Advanced Methods for Acoustic and Thrust Benefits for Aircraft Engine Nozzles *Final Report, 1 Jun. 1996 - 31 Dec. 1999*

Morgan, Morris H., III, Hampton Univ., USA; Gilinsky, Mikhail M., Hampton Univ., USA; March 2000; 19p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG1-1835; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Fluid Mechanics and Acoustics Laboratory (FM&AL) was established At Hampton University in June of 1996. In addition, the FM&AL jointly conducted research with the Central AeroHydrodynamics Institute (TsAGI, Moscow) in Russia under a 2.5 year Civilian Research and Development Foundation (CRDF). The goals of the FM&AL programs are two fold: 1) to improve the working efficiency of the FM&AL team in generating new innovative ideas and in conducting research in the field of fluid dynamics and acoustics, basically for improvement of supersonic and subsonic aircraft engines, and 2) to attract promising minority students to this research and training and, in cooperation with other HU departments, to teach them basic knowledge in

Aerodynamics, Gas Dynamics, and Theoretical and Experimental Methods in Aeroacoustics and Computational Fluid Dynamics (CFD). The research at the FM&AL supports reduction schemes associated with the emission of engine pollutants for commercial aircraft and concepts for reduction of observables for military aircraft. These research endeavors relate to the goals of the NASA Strategic Enterprise in Aeronautics concerning the development of environmentally acceptable aircraft. It is in this precise area, where the US aircraft industry, academia, and Government are in great need of trained professionals and which is a high priority goal of the Minority University Research and Education (MUREP) Program, that the HU FM&AL can make its most important contribution. This project already benefits NASA and HU because: First, the innovation, testing, and further development of new techniques for advanced propulsion systems are necessary for the successful attainment of the NASA Long Term Goals in Aeronautics and Space Transportation Technology (ASTT) including Global Civil Aviation, Revolutionary Technology Leaps, Access to Space, R&D Services, and the economic competitiveness of the US Aircraft Industry in the 2 1 st century. Secondly, the joint theoretical and experimental research and training by the GRC-HU Teams aids: using advanced methods and experience in Aerospace Engineering for domestic industries and training of HU students for interesting innovative work in the numerical simulation field as well as engineering and experimental research. HU students use and modify existing numerical codes for the solution of actual applied problems of the NASA Langley Research Center (LaRC)
Derived from text
Nozzle Efficiency; Engine Design; Aircraft Engines; Aeroacoustics; Gas Dynamics; Hydrodynamics; Thrust

20000064591 NASA Ames Research Center, Moffett Field, CA USA
Functionality Improvements to Overaero
Gee, Ken, MCAT Inst., USA; Rizk, Yehia M., NASA Ames Research Center, USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The functionality of the overset, static aeroelasticity, Navier-Stokes flow solver OVERAERO was increased by adding capability to the flow solver and enhancing code performance. Improvements were made to the fluids/structure interface, an MLP version of the parallel OVERAERO code was developed, and the OVERAERO-MPI code was ported to the Cray T3E. The OVERFLOW-MPI and OVERAERO-MPI codes were tested successfully on the IPG testbed and a means of reducing communication overhead within OVERFLOW-MPI was investigated. to solve an aeroelastic problem computationally, a structures grid surface definition and a fluids grid surface definition are required. Typically, the structures grid surface has a lower fidelity than the fluids grid surface. Thus, the methods developed to transfer data between the two grid systems are vital to the accuracy and efficiency of the aeroelasticity code. The fluids/structures interface developed for the OVERAERO code was improved to more accurately treat fluids surfaces that bridge between two different structural surfaces. For example, the method allowed the forward portion of a flap track fairing to deform with the wing and the aft end of the fairing to deform with the flap. A tightly-coupled version of the code based on OVERFLOW-MLP was developed to improve code performance on the SGI Origin 2000. This required a new parallelization strategy to couple the fluids and structures codes. The OVERAERO-MPI code was ported to the Cray T3E to extend the usability of the code. The port required extensive use of dynamic memory management techniques to fit large problems within the memory limitations of the T3E. The OVERFLOW-MPI and OVERAERO-MPI codes were tested on the IPG testbed being developed within NASA. For small problems with minimal data transfer between grids, there was little to no performance penalty spreading the computation across two machines. For very large problems, methods were developed to minimize intermachine communication via the grid partitioning scheme. by minimizing the intermachine communication requirements of the problem, it may still be beneficial to run a tightly-coupled flow solver across two machines within the IPG.
Author
Aeroelasticity; Computational Grids; Distributed Processing; Computer Systems Design; Distributed Memory

20000064601 Boeing Commercial Airplane Co., Seattle, WA USA
Large Scale Navier-Stokes Calculations of a Transport Airplane Configuration
Yu, N. J., Boeing Commercial Airplane Co., USA; Kao, T. J., Boeing Commercial Airplane Co., USA; Bogue, D. R., Boeing Commercial Airplane Co., USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Large scale Navier-Stokes calculations of a transport airplane configuration at cruise as well as at off-design conditions are presented. Computational results show good correlation with wind tunnel data both in lift and in pitching moment. At flight Reynolds number, the effects of vortex generators on wing pressures and shock movements are also predicted correctly. The study utilizes multi-block, structured grids to solve thin layer Navier-Stokes equations for a complete twin-engine airplane configuration. Point matched, multiblock grids are used for most cases. However, at flight Reynolds number, patched or mismatched multi-block grids are used in vortex generator regions in order to resolve local flow field details generated by vortex

generators. Included figures compare the lift and pitching moment with wind tunnel data. Computational results predict airplane lift and pitch characteristics correctly, including the onset angle of attack for pitch up and pitch down. The maximum lift is lower than test data due primarily to larger separation regions predicted by the present analysis. Another figure shows effects of vortex generators on wing pressures at cruise Mach, flight Reynolds number, and maximum lift condition. With vortex generators deployed, the size of shock induced separation reduces significantly, and thus improves outboard wing loading and airplane pitch characteristics. The present study utilizes 15 to 21 million grid points. Calculations were carried out on NAS Origin 2000 machine using 36 to 60 CPUs concurrently. A parallel efficiency of 90 - 95% was achieved through the use of Message Passing Interface (MPI) in the TLNS3DMB code developed at NASA Langley. This work shows that efficient, large scale aerodynamic calculations can be done on fast, parallel machines. Additional information is contained in the original.
Author
Computational Grids; Multiblock Grids; Navier-Stokes Equation; Reynolds Number; Transport Aircraft; Vortex Generators

20000064609 Boeing Commercial Airplane Co., Seattle, WA USA
Navier-Stokes Prediction of Inlet Flow Fields
Reyhner, Theodore A., Boeing Commercial Airplane Co., USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The Boeing Company has a well-developed process to design the inlets used on its commercial jet aircraft. The process uses potential flow analysis and empirical rules for determining when the flow separates. A project has been underway for some time to determine if existing Navier-Stokes analysis capability has reached the stage where improved designs can be achieved, particularly for configurations outside the envelope that was used for generating the empirical rules. This requires that both separated and attached flow fields be accurately predicted. The current work on this project involves the use of two government Navier-Stokes computer codes, tlns3d-mb and Wind. Both codes are designed to run in a parallel mode to reduce wall clock time. Parallel computing is done using zone decomposition with one of more zones assigned to a processor. Parallel computing has used MPI and PVM message passing. Parallel computing has proven essential to obtaining results within a reasonable time period. This paper will specifically report on an effort to use Navier-Stokes analysis to predict the performance of an advanced inlet. The original design did not perform as well as expected in model-scale, wind-tunnel testing. The object of this project was to determine why and develop a reliable tool to be used for an improved design. Predictions were done for the inlet operating in the presence of a ground plane (runway) with a crosswind at zero forward speed, a critical design point for inlet operation. The Wind Navier-Stokes code was used with structured Chimera grids having about five million grid points and divided into 30 to 40 zones. Fine grid calculations used 30 processors. The computations were made using the NAS SGI Origin computing cluster. Analysis predictions agreed with data, predicting the onset of separation and the details of the flow field for attached and separated flows, including the effects of the ground vortex. The analysis proved capable of predicting the influence of the wind-tunnel walls on the measured flow field. Part of the effort was directed at determining grid topology and density requirements and identifying the best procedure for running the code. A process has been developed that can provide flow prediction results in several days for a new design. Predictions correspond well with experiment, but additional test cases are needed to increase confidence in the procedure.
Author
Computational Fluid Dynamics; Inlet Flow; Navier-Stokes Equation; Parallel Processing (Computers); Structured Grids (Mathematics); Engine Inlets

20000064697 Texas Univ., William B. Hanson Center for Space Studies, Dallas, TX USA
Ion Mass Spectrometer for Sporadic-E Rocket Experiments
Heelis, R. A., Texas Univ., USA; Earle, G. D., Texas Univ., USA; Pfaff, Robert, NASA Goddard Space Flight Center, USA; [2000]; 13p; In English
Contract(s)/Grant(s): NAG5-5086
Report No.(s): UTD-FINS-630635; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

NASA grant NAG5-5086 provided funding for the William B. Hanson Center for Space Sciences at the University of Texas at Dallas (UTD) to design, fabricate, calibrate, and ultimately fly two ion mass spectrometer instruments on a pair of sounding rocket payloads. Drs. R.A. Heelis and G.D. Earle from UTD were co-investigators on the project. The principal investigator for both rocket experiments was Dr. Robert Pfaff of the Goddard Space Flight Center. The overall project title was "Rocket/Radar Investigation of Lower Ionospheric Electrodynamics Associated with Intense Mid-Latitude Sporadic-E Layers". This report

describes the overall objectives of the project, summarizes the instrument design and flight experiment details, and presents representative data obtained during the flights.
Derived from text
Mass Spectrometers; Fabrication; Aerospace Engineering; Sounding Rockets; Aerodynamics

20000065643 Cornell Univ., Cornell Fracture Group, Ithaca, NY USA
Simulating Fatigue Crack Growth in Spiral Bevel Gears *Final Report*
Spievak, Lisa E., Cornell Univ., USA; Wawrzynek, Paul A., Cornell Univ., USA; Ingraffea, Anthony R., Cornell Univ., USA; May 2000; 126p; In English
Contract(s)/Grant(s): NAG3-1993; RTOP 581-30-13; DA Proj. 1L1-62211-A-47-A
Report No.(s): NASA/CR-2000-210062; E-12287; NAS 1.26:210062; ARL-CR-451; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The majority of helicopter transmission systems utilize spiral bevel gears to convert the horizontal power from the engine into vertical power for the rotor. Due to the cyclical loading on a gear's tooth, fatigue crack propagation can occur. In rotorcraft applications, a crack's trajectory determines whether the gear failure will be benign or catastrophic for the aircraft. As a result, the capability to predict crack growth in gears is significant. A spiral bevel gear's complex shape requires a three dimensional model of the geometry and cracks. The boundary element method in conjunction with linear elastic fracture mechanics theories is used to predict arbitrarily shaped three dimensional fatigue crack trajectories in a spiral bevel pinion under moving load conditions. The predictions are validated by comparison to experimental results. The sensitivity of the predictions to variations in loading conditions and crack growth rate model parameters is explored. Critical areas that must be understood in greater detail prior to predicting more accurate crack trajectories and crack growth rates in three dimensions are identified.
Author
Crack Propagation; Fatigue (Materials); Spiral Bevel Gears; Computerized Simulation; Mathematical Models; Rotary Wing Aircraft

20000058169 Cornell Univ., Cornell Fracture Group, Ithaca, NY USA
Crack Turning and Arrest Mechanisms for Integral Structure
Pettit, Richard, Cornell Univ., USA; Ingraffea, Anthony, Cornell Univ., USA; Dec. 31, 1999; 44p; In English
Contract(s)/Grant(s): NAG1-2013
Report No.(s): OSP-34049; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In the course of several years of research efforts to predict crack turning and flapping in aircraft fuselage structures and other problems related to crack turning, the 2nd order maximum tangential stress theory has been identified as the theory most capable of predicting the observed test results. This theory requires knowledge of a material specific characteristic length, and also a computation of the stress intensity factors and the T-stress, or second order term in the asymptotic stress field in the vicinity of the crack tip. A characteristic length, r(sub c), is proposed for ductile materials pertaining to the onset of plastic instability, as opposed to the void spacing theories espoused by previous investigators. For the plane stress case, an approximate estimate of r(sub c), is obtained from the asymptotic field for strain hardening materials given by Hutchinson, Rice and Rosengren (HRR). A previous study using of high order finite element methods to calculate T-stresses by contour integrals resulted in extremely high accuracy values obtained for selected test specimen geometries, and a theoretical error estimation parameter was defined. In the present study, it is shown that a large portion of the error in finite element computations of both K and T are systematic, and can be corrected after the initial solution if the finite element implementation utilizes a similar crack tip discretization scheme for all problems. This scheme is applied for two-dimensional problems to a both a p-version finite element code, showing that sufficiently accurate values of both K(sub I) and T can be obtained with fairly low order elements if correction is used. T-stress correction coefficients are also developed for the singular crack tip rosette utilized in the adaptive mesh finite element code FRANC2D, and shown to reduce the error in the computed T-stress significantly. Stress intensity factor correction was not attempted for FRANC2D because it employs a highly accurate quarter-point scheme to obtain stress intensity factors.
Derived from text
Stress Distribution; Crack Arrest; Cracks; Aircraft Structures; Strain Hardening; Shear Stress

20000064588 Washington Univ., Dept. of Aeronautics and Astronautics, Seattle, WA USA
Efficient Nonlinear CFD-Based Aeroelastic Analysis for Multiple Load Cases in Preliminary Design
Knill, Duane, Washington Univ., USA; Bhatia, Kumar, Boeing Co., USA; Tamigniaux, Thierry, Boeing Co., USA; Yaghmaee, Sasan, Boeing Co., USA; Rausch, Russ, Boeing Co., USA; February 2000; In English; See also 20000064579; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Predicting reliable aeroelastic loads information for the design of real subsonic transport airplanes is an expensive, time-consuming process of critical importance to the design effort as a whole. The importance of the aeroelastic loads process indicates that the most accurate nonlinear computational fluid dynamics (CFD) tools should be used. On the other hand, the computational expense of performing the numerous aerodynamic analyses that are required for loads analysis on complete aircraft configurations (wing, fuselage, strut/nacelle, empennage, control surfaces, vortex generators) operating under critical flight conditions has traditionally forced the use of wind tunnel corrected linear aerodynamic models instead of nonlinear CFD. The 3-Stage Aeroelastic Loads Process being developed at The Boeing Company is designed to recognize the importance of using accurate nonlinear CFD solutions while appreciating the facts that the aeroelastic loads process requires analysis of thousands of load cases and accurate nonlinear CFD analyses of real configurations are costly and time consuming. The Boeing 3-Stage Aeroelastic Loads Process uses detailed CFD models and their sensitivities with respect to shape variations of a base configuration to bridge the gap between linear loads methods and nonlinear CFD-based loads methods. The initial focus of this research is on the development and testing of a prototype 3-Stage Aeroelastic Loads Process. In this step, a simplified wing-fuselage-empennage configuration will be analyzed within a relatively coarse aeroelastic loads database. This will serve to lay the groundwork for developing the general procedure and evaluating the necessary tools for use in the next step, which will focus on the application of the 3-Stage Process in a realistic industry aircraft loads setting using a complete subsonic transport aircraft geometry. For the preliminary design analysis, the Boeing target is to complete a loads analysis within a multidisciplinary optimization environment in 2-3 days of flow time. Achieving this aggressive goal will require the use and advancement of high-performance parallel computing capabilities. In the development step of this research, Navier-Stokes solutions are obtained using the HiMAP/G03D solver. Studies have benchmarked the code's accuracy with respect to industry standards and parallel computing capabilities on large numbers of processors on the NAS/HPCCP Origin-2000 cluster. The goals of this work are to provide more accurate loads analysis for subsonic transports, thereby reducing uncertainty, allowing smaller margins, reducing required rework, and ultimately reducing cost. This research is being conducted in a realistic industry Structures and Loads environment, and is expected to make an impact on loads prediction throughout the aerospace industry. Additional information is contained in the original.
Author
Aerodynamic Loads; Aeroelasticity; Aircraft Configurations; Body-Wing Configurations; Computational Fluid Dynamics; Navier-Stokes Equation; Nonlinearity; Design Analysis

13
GEOSCIENCES (GENERAL)

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology.

20000064570 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
The AVIRIS Low Altitude Option-An Approach to Increase Geometric Resolution and Improve Operational Flexibility Simultaneously
Sarture, Charles M., Jet Propulsion Lab., California Inst. of Tech., USA; Chovit, Christopher J., Jet Propulsion Lab., California Inst. of Tech., USA; Chrien, Thomas G., Jet Propulsion Lab., California Inst. of Tech., USA; Eastwood, Michael L., Jet Propulsion Lab., California Inst. of Tech., USA; Green, Robert O., Jet Propulsion Lab., California Inst. of Tech., USA; Kurzwell, Charles G., Jet Propulsion Lab., California Inst. of Tech., USA; Summaries of the Seventh JPL Airborne Earth Science Workshop January 12-16, 1998; Dec. 19, 1998; Volume 1, pp. 365; In English; See also 20000064520; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

From 1987 through 1997 the Airborne Visible-InfraRed Imaging Spectrometer has matured into a remote sensing instrument capable of producing prodigious amounts of high quality data. Using the NASA/Ames ER-2 high altitude aircraft platform, flight operations have become very reliable as well. Being exclusively dependent on the ER-2, however, has limitations: the ER-2 has a narrow cruise envelope which fixes the AVIRIS ground pixel at 20 meters; it requires a significant support infrastructure; and it has a very limited number of bases it can operate from. In the coming years, the ER-2 will also become less available for AVIRIS flights as NASA Earth Observing System satellite underflights increase. Adapting AVIRIS to lower altitude, less specialized aircraft will create a much broader envelope for data acquisition, i.e., higher ground geometric resolution while maintaining nearly the ideal spatial sampling. This approach will also greatly enhance flexibility while decreasing the overall cost of flight operations and field support. Successful adaptation is expected to culminate with a one-month period of demonstration flights.
Author
Airborne Equipment; Flight Altitude; Flight Operations; Low Altitude; Remote Sensing; U-2 Aircraft

20000060861 Nature Conservancy, Arlington, VA USA

Providing the Air Force with Data on Species Sensitive to Noise from Low Flying Aircraft *Annual Report, 15 Aug. 1998 - 14 Feb. 2000*

Howie, Shara; Brugger, Carrie; Feb. 2000; 122p; In English

Contract(s)/Grant(s): DAMD17-98-2-8016

Report No.(s): AD-A377206; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In order to comply with the Endangered Species Act (ESA) and the National Environmental Policy Act (NEPA), the ACC must evaluate its air operations for impacts to noise sensitive wildlife. The areas used for training flights change, the list of species believed sensitive to noise changes, the species and the species information are dynamic. Accordingly, in order to continuously evaluate impacts of training flights on Sensitive wildlife species and to comply with the ESA and NEPA, ACC has developed a Geographic Information System that is geographically complete and easy to update. The major objectives of this project were to provide the Air Force with access to a GIS-compatible data layer identifying the locations of noise sensitive species in Arizona, New Mexico and the tribal lands of the Navajo Nation in those two states while also building a portion of the Multi-Jurisdictional Dataset (MJD), an aggregation of data on the location and condition of species of conservation interest on a national scale. The objective of the MJD is to facilitate access to data and information products based on a national data set which is refreshed yearly. Through the MJD, ABI in conjunction with the Natural Heritage Programs can provide the Air Force with access to a GIS-compatible data layer identifying the locations of species at a national distribution. Natural Heritage Programs in Arizona, Navajo Nation and New Mexico improved the quality and completeness of locational data on animal species of conservation to meet the benchmark standards established by the ABI Data Standards Committee. The Nature Conservancy provided ACC with data and information on the status and exact locations of noise sensitive wildlife species (See Appendix 2A & 2B) in Arizona, New Mexico and the tribal lands of the Navajo Nation in those two states while adding this data to the broader effort to create the MJD.

DTIC

Aircraft Noise; Noise Pollution; Low Altitude; Endangered Species

20000064012 NASA Marshall Space Flight Center, Huntsville, AL USA

A Comparison of the Automated Meteorological Profiling System High Resolution Flight Element to the Kennedy Space Center 50 MHz Doppler Wind Profiler

Roberts, Barry C., NASA Marshall Space Flight Center, USA; Leahy, Frank, Raytheon Co., USA; [2000]; 5p; In English; 9th; Aviation, Range and Aerospace Meteorology, 11-15 Sep. 2000, Orlando, FL, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Wind profile measurement and the simulation of aerodynamic loads on a launch vehicle play an important role in determining launch capability and post launch assessment of the vehicle's performance. to date, all USA range certified wind profile measurement systems have been based on balloon tracking. Since the 1960's, the standard used by the National Aeronautics and Space Administration and the Air Force at the Cape Canaveral Air Station (CCAS) for detailed wind profile measurements has been the radar tracked, aerodynamically stabilized Jimsphere balloon system. Currently, the Air Force is nearing certification and operational implementation of the Automated Meteorological Profiling System (AMPS) at CCAS and Vandenburg Air Force Base (VAFB). AMPS uses the Global Positioning System for tracking the Jimsphere balloon. It is anticipated that the AMPS/Jimsphere, named the High Resolution Flight Element (HRFE), will have equivalent, or better resolution than the radar tracked Jimsphere, especially when the balloon is far downrange, at a low elevation angle. by the 1980's, the development of Doppler Wind Profilers (DWP) had become sufficiently advanced to justify an experimental measurement program at Kennedy Space Center (KSC). In 1989 a 50 MHz DWP was installed at KSC. In principal, the 50 MHz DWP has the capability to track the evolution of wind profile dynamics within 5 minutes of a launch. Because of fundamental differences in the measurement technique, there is a significant time and space differential between 50 MHz DWP and HRFE wind profiles. This paper describes a study to quantify these differences from a sample of 50 MHz DWP/HRFE pairs obtained during the AMPS certification test program.

Author

Aerodynamic Loads; High Resolution; Wind Profiles; Jimsphere Balloons; Wind (Meteorology); Automatic Control; Doppler Radar

14
LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions.

20000068935 Civil Aeromedical Inst., Oklahoma City, OK USA
Prevalence of Drugs and Alcohol in Fatal Civil Aviation Accidents Between 1994 and 1998 *Final Report*
Canfield, Dennis V., Civil Aeromedical Inst., USA; Hordinsky, Jerry, Civil Aeromedical Inst., USA; Millett, David P., Federal Aviation Administration, USA; Endecott, Boyd, Civil Aeromedical Inst., USA; Smith, Dudley, Civil Aeromedical Inst., USA; June 2000; 12p; In English
Contract(s)/Grant(s): AM-B-98-TOX-202
Report No.(s): DOT/FAA/AM-00/21; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of drugs and alcohol in aviation is closely monitored by the FAA Office of Aviation Medicine's (OAM's) Civil Aeromedical Institute (CAMI) through the toxicological analysis of specimens from pilots who have died in aviation accidents. This information on the use of drugs in aviation is helpful to the FAA in developing programs to reduce the usage of dangerous drugs and identify potentially incapacitating medical conditions that may cause an accident. Data collected from this research can be used to evaluate the effectiveness of the FAA drug testing program. The toxicology reports prepared by the CAMI Forensic Toxicology Research Section are used by the FAA and the National Transportation Safety Board to determine the cause of aviation accidents. Specimens (blood, urine, liver, kidney, vitreous fluid, and other bodily specimens) were collected by pathologists near the accident and placed in evidence containers provided by CAMI. These samples were refrigerated and shipped by overnight air. Upon receipt, the specimens were inventoried and accessioned for the analysis of drugs, alcohol, carbon monoxide, and cyanide. All data collected by the laboratory were entered into a computer database for future analysis. The database was searched using a Microsoft Access TM program developed by a local contractor. The database was sorted based on the class of drug, controlled dangerous substance schedules I and II, controlled dangerous substance schedules III-V, prescription drugs, over-the-counter drugs, and alcohol. The Toxicology and Accident Research Laboratory received specimens from 1683 pilots for postmortem toxicology analysis between 1994 to 1998. Controlled dangerous substances, CDS, (schedules I and II) were found in 89 of the pilots analyzed. Controlled dangerous substances (schedules III - V) were found in 49 of the pilots tested. Prescription drugs were found in 240 of the pilots analyzed. Over-the-counter drugs were found in 301 of the pilots analyzed. Alcohol at or above the legal limit of 0.04% was found in 124 pilots. The number of positive drug cases has doubled over the past 5 years. Over-the-counter medications are the most frequently found drugs in fatal aviation accidents and many of these drugs, or the medical conditions for which they are being used, could impair a pilot's ability to safely fly an aircraft. The increased number of positive cases found in this research is most likely the result of improved methods of analysis, rather than an increase in the use of drugs. The low incidence of CDS III-V drugs found in fatal aviation accidents may be a result of the difficulty in finding and identifying the new benzodiazepines commonly prescribed in this class.
Author

Aircraft Accidents; Alcohols; Civil Aviation; Drugs; Death; Aerospace Medicine; Aircraft Pilots

20000064711 Massachusetts Inst. of Tech., Dept. of Aeronautics and Astronautics, Cambridge, MA USA
Situational Awareness Issues in the Implementation of Datalink: Shared Situational Awareness in the Joint Flight Deck-ATC Aviation System *Final Report, 1 Jan. 1991 - 30 Sep. 1999*
Hansman, Robert John, Jr., Massachusetts Inst. of Tech., USA; [1999]; 7p; In English
Contract(s)/Grant(s): NAG2-716; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

MIT has investigated Situational Awareness issues relating to the implementation of Datalink in the Air Traffic Control environment for a number of years under this grant activity. This work has investigated: 1) The Effect of "Party Line" Information. 2) The Effect of Datalink-Enabled Automated Flight Management Systems (FMS) on Flight Crew Situational Awareness. 3) The Effect of Cockpit Display of Traffic Information (CDTI) on Situational Awareness During Close Parallel Approaches. 4) Analysis of Flight Path Management Functions in Current and Future ATM Environments. 5) Human Performance Models in Advanced ATC Automation: Flight Crew and Air Traffic Controllers. 6) CDTI of Datalink-Based Intent Information in Advanced ATC Environments. 7) Shared Situational Awareness between the Flight Deck and ATC in Datalink-Enabled Environments. 8) Analysis of Pilot and Controller Shared SA Requirements & Issues. 9) Development of Robust Scenario Generation and Distributed Simulation Techniques for Flight Deck ATC Simulation. 10) Methods of Testing Situation Awareness Using Testable

Response Techniques. The work is detailed in specific technical reports that are listed in the following bibliography, and are attached as an appendix to the master final technical report.
Derived from text
Air Traffic Control; Data Links; Avionics; Human Factors Engineering

20000068483 NASA Marshall Space Flight Center, Huntsville, AL USA
International Space Station Sustaining Engineering: A Ground-Based Test Bed for Evaluating Integrated Environmental Control and Life Support System and Internal Thermal Control System Flight Performance
Ray, Charles D., NASA Marshall Space Flight Center, USA; Perry, Jay L., NASA Marshall Space Flight Center, USA; Callahan, David M., ION Corp., USA; [2000]; 31p; In English; 30th; 7th; Environmental Systems, 10-13 Jul. 2000, Toulouse, Toulouse, France, France; Sponsored by Society of Automotive Engineers, Inc., USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As the International Space Station's (ISS) various habitable modules are placed in service on orbit, the need to provide for sustaining engineering becomes increasingly important to ensure the proper function of critical onboard systems. Chief among these are the Environmental Control and Life Support System (ECLSS) and the Internal Thermal Control System (ITCS). Without either, life onboard the ISS would prove difficult or nearly impossible. For this reason, a ground-based ECLSS/ITCS hardware performance simulation capability has been developed at NASA's Marshall Space Flight Center. The ECLSS/ITCS Sustaining Engineering Test Bed will be used to assist the ISS Program in resolving hardware anomalies and performing periodic performance assessments. The ISS flight configuration being simulated by the test bed is described as well as ongoing activities related to its preparation for supporting ISS Mission 5A. Growth options for the test facility are presented whereby the current facility may be upgraded to enhance its capability for supporting future station operation well beyond Mission 5A. Test bed capabilities for demonstrating technology improvements of ECLSS hardware are also described.
Author
Ground Tests; Test Facilities; Environmental Control; Life Support Systems; Simulation; Flight Characteristics

20000069847 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
USN/USMC Ejection Seat Equipped Aircraft Anthropometric Accommodation
Kennedy, Greg; Jan. 1999; 14p; In English
Report No.(s): AD-A377912; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

USN/USMC ejection Seat equipped aircraft anthropometric accommodation guidance is outdated and undocumented. Recent reassignments of aviators within the USN/USMC have highlighted an area where operational dollars could be saved by assigning candidate aviators to a correct and safe pipeline. These issues were revealed during the course of NAVAIRSYSCOM (PMA-202) Aircrew Accommodation Expansion Program where AIR 4.6, Patuxent River was tasked to perform a baseline accommodation assessment of in-service USN/USMC aircraft. The methods used in the program approach were different than procedures historically used to determine USN/USMC aviator suitability and to verify cockpit design. A multivariate statistical approach was employed and served as the basis for determining the safe accommodation envelope. The revised guidance suggested here accounts for: (1) The location of the scat with respect to the competing variables that drive the seat location; (2) The operational use of the anthropometric accommodation guidance and pipeline relational charting; and (3) The cost avoidance associated with inappropriately assigning aviators. These revised guides help to define the acceptable range of aircrew anthropometric dimensions that must be satisfied to achieve safety of flight and mission of effectiveness.
DTIC
Aircraft; Ejection Seats; Anthropometry; Multivariate Statistical Analysis; Aircraft Pilots

20000070335 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Helicopter Aircrew Integrated Life Support System (HAILSS) Aircraft Integration Tests
Reason, William; Apr. 1999; 6p; In English
Report No.(s): AD-A377892; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Helicopter Aircrew Integrated Life Support System (HAILSS) ensemble is an impermeable coverall designed for protection in the Chemical and Biological threat arena. Additionally, the garment can be used as an anti-exposure system because the impermeable fabric effectively makes the garment a dry suit. It has booties sewn and sealed at the ankles and butyl rubber neck and wrist seals. The system employs a mesh spacer material that provides for conditioned air flow through the garment with one-way check valves on each lower sleeve for conditioned air exhaust. The entire ensemble is worn over a skin tight moisture

wicking underwear. The systems is provided with protective head gear including a modified HGU-56/P two-part helmet with an integrated hood that provides for goggle demisting and aviator respiration.
DTIC
Life Support Systems; Aircraft Pilots; Systems Integration

15
MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science.

20000061434 Rensselaer Polytechnic Inst., Mechanical Engineering, Aeronautical Engineering and Mechanics, Troy, NY USA
Soft Computing in Multidisciplinary Aerospace Design: New Directions for Research
Hajela, Prabhat, Rensselaer Polytechnic Inst., USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 17-1 - 17-13; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

There has been increased activity in the study of methods for multidisciplinary analysis and design. This field of research has been a busy one over the past decade, driven by advances in computational methods and significant new developments in computer hardware. There is a concern, however, that while new computers will derive their computational speed through parallel processing, current algorithmic procedures that have roots in serial thinking are poor candidates for use on such machines - a paradigm shift is required! Among new advances in computational methods, soft computing techniques have enjoyed a remarkable period of development and growth. of these, methods of neural computing, evolutionary search, and fuzzy logic have been the most extensively explored in problems of multidisciplinary analysis and design. The paper will summarize important accomplishments to-date, of neurocomputing, fuzzy-logic, and evolutionary search, including immune network modeling, in the field of multidisciplinary aerospace design.
Author
Algorithms; Computation; Fuzzy Systems; Aircraft Design; Hardware

20000061451 DaimlerChrysler Aerospace A.G., Ottobrun, Germany
Rapid Generation of Conceptual and Preliminary Design Aerodynamic Data by a Computer Aided Process
Fornasier, Luciano, DaimlerChrysler Aerospace A.G., Germany; Gottmann, Thomas, DaimlerChrysler Aerospace A.G., Germany; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 35-1 - 35-11; In English; See also 20000061419; Sponsored in part by the JULIUS partners; Copyright Waived; Avail: CASI; A03, Hardcopy

A multidisciplinary integration framework (MIDAS- an acronym for Multidisciplinary Integration for Design and Analysis Software) is developed for a quick and accurate assessment of aircraft performance. The system allows for the continues integration of the conceptual and preliminary design stages. The MIDAS system is starting from the definition of the configuration layout to provide basic aerodynamic data- for performance analysis, sizing, structural layout and early handling qualities. The first aerodynamic dataset is provided by an Excel-based module in a highly automated way. This data base can be updated by computational and experimental fluid dynamics findings. Another MIDAS module integrate the preparation of CFD meshes. The paper deals with the integration of aerodynamic methods within the aircraft design.
Author
Aircraft Design; Computer Aided Design; Computer Techniques; Reliability Analysis

20000061435 Liege Univ., Aerodynamics Group, Belgium
An Optimal Control Theory Based Algorithm to Solve 2D Aerodynamic Shape Optimisation Problems for Inviscid and Viscous Flows
Hiernaux, S., Belgian National Foundation for Scientific Research, Belgium; Essers, J.–A., Liege Univ., Belgium; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 18-1 - 18-12; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

With the capacity of today's computers, one can envisage the resolution of shape optimization problems in aerodynamics. Nevertheless, optimization methods require many evaluations of different aero-dynamic configurations, and so are much more expensive than a single analysis. It is therefore mandatory to find methods that evaluate aerodynamic functions and their gradient at the lowest possible computational cost, as well as fast and robust optimization methods. Classical optimization techniques (descent methods) not only require the value of the function to optimize, but also of its gradient. The classical way to compute

the gradient is to use a finite-difference formula; the main drawback of this method is due to the fact that n + 1 evaluations of aerodynamic functions are necessary at each iteration, n being the number of parameters defining the geometry to optimize. So, such methods are completely un-suited to aerodynamic shape optimization, because of the high computational cost of the single analysis. Alternative methods (stochastic optimization, genetic algorithms) that don#t require gradient information are also highly costly in term of CPU time. For a few years, techniques for sensitivity analysis based on the optimal control theory have been developed. These techniques derive from the state equations another set of equations called "adjoint" or "costate" equations. The solution of these adjoint equations is used to compute the gradient at very low cost; since solving the adjoint equations is equivalent to solve the state equations, the cost of sensitivity analysis is greatly reduced. Some authors use adjoint equations derived from the discretized Euler equations. In this paper, we focus on adjoint equations derived from analytical state equations.
Author
Control Theory; Optimal Control; Two Dimensional Models; Aerodynamic Configurations; Viscous Flow; Shapes; Genetic Algorithms

20000063536 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Biomorphic Explorers
Thakoor, Sarita, Jet Propulsion Lab., California Inst. of Tech., USA; [1999]; 19p; In English; Biologically Inspired Approaches for MAV's, 21-22 Apr. 1999, Alexandria, VA, USA; Sponsored by Defense Advanced Research Projects Agency, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents, in viewgraph form, the first NASA/JPL workshop on Biomorphic Explorers for future missions. The topics include: 1) Biomorphic Explorers: Classification (Based on Mobility and Ambient Environment); 2) Biomorphic Flight Systems: Vision; 3) Biomorphic Explorer: Conceptual Design; 4) Biomorphic Gliders; 5) Summary and Roadmap; 6) Coordinated/Cooperative Exploration Scenario; and 7) Applications. This paper also presents illustrations of the various biomorphic explorers.
CASI
Biology; Animals; Classifications; Wildlife; Aerodynamics

16
PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics.

20000060845 Department of Transportation, John A. Volpe National Transportation Systems Center Acoustics Facility, Cambridge, MA USA
Lateral Attenuation of Aircraft Sound Levels Over an Acoustically Hard Water Surface: Logan Airport Study ***Final Report, August 1998 - May 2000***
Senzig, David A., Department of Transportation, USA; Fleming, Gregg G., Department of Transportation, USA; Clarke, John–Paul B., Massachusetts Inst. of Tech., USA; May 2000; 98p; In English
Report No.(s): NASA/CR-2000-210127; DOT-VNTSC-NASA-00-01; NAS 1.26:210127; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

The National Aeronautics and Space Administration (NASA), Langley Research Center (LaRC), sponsored the Acoustics Facility at the USA Department of Transportation's John A. Volpe National Transportation Systems Center (Volpe Center) and the Massachusetts Institute of Technology (MIT) to conduct a noise measurement study at Logan International Airport in Boston, Massachusetts, during the summer of 1999 to examine the applicability of currently available mathematical models of lateral attenuation. Analysis of the data collected revealed that lateral attenuation is a function of aircraft geometry. Lateral attenuation for aircraft with tailmounted engines was found to agree with the published literature, as well as that included in existing aircraft noise models. Lateral attenuation for aircraft with wing-mounted engines was found to be less than documented in the literature. This lower lateral attenuation for aircraft with wing-mounted engines results in a general under-prediction of side-line noise in the existing noise models.
Author
Acoustic Attenuation; Aircraft Noise; Mathematical Models; Noise Measurement; Propulsion System Configurations; Noise Prediction (Aircraft)

20000060850 Wyle Labs., Inc., Arlington, VA USA

Validation of Aircraft Noise Prediction Models at Low Levels of Exposure

Page, Juliet A., Wyle Labs., Inc., USA; Hobbs, Christopher M., Wyle Labs., Inc., USA; Plotkin, Kenneth J., Wyle Labs., Inc., USA; Stusnick, Eric, Wyle Labs., Inc., USA; April 2000; 100p; In English

Contract(s)/Grant(s): NAS1-20103; RTOP 538-03-15-01

Report No.(s): NASA/CR-2000-210112; NAS 1.26:210112; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

Aircraft noise measurements were made at Denver International Airport for a period of four weeks. Detailed operational information was provided by airline operators which enabled noise levels to be predicted using the FAA's Integrated Noise Model. Several thrust prediction techniques were evaluated. Measured sound exposure levels for departure operations were found to be 4 to 10 dB higher than predicted, depending on the thrust prediction technique employed. Differences between measured and predicted levels are shown to be related to atmospheric conditions present at the aircraft altitude.

Author

Aircraft Noise; Noise Prediction (Aircraft); Prediction Analysis Techniques; Noise Measurement; Noise Intensity

20000062459 DYNACS Engineering Co., Inc., Cleveland, OH USA

Influence of Mean-Density Gradient on Small-Scale Turbulence Noise

Khavaran, Abbas, DYNACS Engineering Co., Inc., USA; June 2000; 18p; In English; 6th; Aeroacoustics, 12-14 Jun. 2000, Lahaina, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS3-98008; RTOP 523-90-43

Report No.(s): NASA/CR-2000-210226; E-12346; NAS 1.26:210226; AIAA Paper 2000-2059; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A physics-based methodology is described to predict jet-mixing noise due to small-scale turbulence. Both self- and shear-noise source teens of Lilley's equation are modeled and the far-field aerodynamic noise is expressed as an integral over the jet volume of the source multiplied by an appropriate Green's function which accounts for source convection and mean-flow refraction. Our primary interest here is to include transverse gradients of the mean density in the source modeling. It is shown that, in addition to the usual quadrupole type sources which scale to the fourth-power of the acoustic wave number, additional dipole and monopole sources are present that scale to lower powers of wave number. Various two-point correlations are modeled and an approximate solution to noise spectra due to multipole sources of various orders is developed. Mean flow and turbulence information is provided through RANS-k(epsilon) solution. Numerical results are presented for a subsonic jet at a range of temperatures and Mach numbers. Predictions indicated a decrease in high frequency noise with added heat, while changes in the low frequency noise depend on jet velocity and observer angle.

Author

Turbulence; Sound Waves; Procedures; Noise Spectra; Aerodynamic Noise; Jet Mixing Flow

20000065633 Institute TNO of Applied Physics, Delft, Netherlands

Modelling Tip Vortex Induced Noise

Geerlings, A. C., Institute TNO of Applied Physics, Netherlands; Dec. 20, 1999; 21p; In English

Contract(s)/Grant(s): A99/KM/150; TNO Proj. 008.00065/01.01

Report No.(s): TD-99-0063; HAG-RPT-990239; Copyright; Avail: Issuing Activity

Sound generated by objects in a flow, such as hydrofoils or propellers, is caused by a number of mechanisms. One mechanism is due to the tip vortex, a phenomenon caused by the finite length of airfoils and propeller blades. Noise due to the tip vortex can be considered complementary to other previously studied noise mechanisms such as non-uniform stationary inflow, inflow turbulence and trailing edge noise. In this literature study a first step is made to come to a design for a parameterized model for tip vortex noise. The tip vortex induced partial source contribution completes the existing noise emission model for ship propellers. The proposed model consists of available techniques by which the noise radiation is based on wall pressure fluctuations described by their temporal and spatial spectra. This requires first the availability of the parameters that describe the turbulent layer. Secondly, in order to apply these techniques to tip vortex related noise, the time-varying equilibrium position of the tip vortex is required. For simplified geometries parameter models are available. In case of a complex geometry a numerical solution may be sought by means of Reynolds-Averaged Navier-Stokes (RANS) calculations.

Author

Vortices; Aeroacoustics; Aerodynamic Noise; Propeller Noise; Propeller Blades; Trailing Edges

20000066615 Southampton Univ., Signal Processing and Control Group, UK

Model for the Control of the Sound Radiated by an Aircraft Panel Excited by a Turbulent Boundary Layer

Maury, C., Southampton Univ., UK; Gardonio, P., Southampton Univ., UK; Elliott, S. J., Southampton Univ., UK; June 2000; 90p; In English

Report No.(s): ISVR-TR-287; Copyright; Avail: Issuing Activity

This aim of this report is to present a simplified but relevant model for predicting the vibro-acoustic response of an aircraft panel excited by a turbulent boundary layer. This analytical model provides an insight into tile physical properties of the TBL-excited panel and enables the performance limitations to be derived for various idealized active control systems. This report is divided into three main parts. The first part justifies the simplifying assumptions of the flat plate model for an aircraft panel. Furthermore, it describes how the spectral densities of the panel response can be obtained from an analysis of the system response to a harmonic deterministic excitation and a statistical model for the turbulent boundary layer. The second part focuses on the modal formulation used to solve the flow-structure interaction problem in the frequency domain; criteria are discussed under which the cross-modal coupling of the structural modes call be neglected when excited by a turbulent boundary layer. The modelling of the pressure field induced by the turbulent boundary layer which acts as a distributed random excitation field on the structure is described. The third part presents simulation results in which the verification of the approximations and the influence of the main physical parameters art discussed, together with a comparison between experimental and predicted results. The way in which the structural modes and the radiation modes of the plate contribute to the vibro-acoustic response are also examined. One important conclusion is that for subsonic turbulent flows, each structural mode radiates sound independently. A suitable strategy for the active structural acoustic control of the sound power transmitted through the panel would thus be independent feedback control of each structural mode in the low-frequency domain. It is also shown, however, that independent control of the panel's radiation modes is also possible, and that this could provide a more efficient control strategy, since a smaller number of radiation modes than structural modes needs to be controlled for a given level of performance.

Author

Active Control; Mathematical Models; Panels; Turbulent Boundary Layer; Aircraft Noise; Harmonic Excitation; Harmonic Radiation

20000068518 Wyle Labs., Inc., Arlington, VA USA

Validation of Aircraft Noise Prediction Models at Low Levels of Exposure

Page, Juliet A., Wyle Labs., Inc., USA; Hobbs, Christopher M., Wyle Labs., Inc., USA; Plotkin, Kenneth J., Wyle Labs., Inc., USA; Stusnick, Eric, Wyle Labs., Inc., USA; April 2000; 102p; In English

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Report No.(s): NASA/CR-2000-210112; NAS 1.26:210112; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Aircraft noise measurements were made at Denver International Airport for a period of four weeks. Detailed operational information was provided by airline operators which enabled noise levels to be predicted using the FAA's Integrated Noise Model. Several thrust prediction techniques were evaluated. Measured sound exposure levels for departure operations were found to be 4 to 10 dB higher than predicted, depending on the thrust prediction technique employed. Differences between measured and predicted levels are shown to be related to atmospheric conditions present at the aircraft altitude.

Author

Aircraft Noise; Noise Prediction (Aircraft); Prediction Analysis Techniques; Mathematical Models; Noise Measurement

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SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula.

20000066583 NASA Kennedy Space Center, Cocoa Beach, FL USA

A/C 67 Investigation Board Final Report

May 11, 1987; In English; Videotape: 27 min., 41 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-2000078606; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

On March 26, 1987, after the launch of an Atlas/Centaur rocket with a payload of a Navy Communications Satellite, a problem developed and the rocket was lost. John Busse chaired the Accident Investigation Board that was convened to investigate the incident. This videotape is a press conference with Mr Busse, who reviews the findings of the investigation concerning the loss of the Atlas/Centaur-67 launch vehicle. The loss is primarily attributed to a hardover engine yaw command that was caused by an erroneous signal from the digital computer unit. The generation of the erroneous signal is blamed on unfavorable weather

conditions which created a lightning hazard. Mr. Busse, also, reviews the investigation's recommendations for avoiding similar occurrences. The press then asks questions about the findings and recommendations.
CASI
Accident Investigation; Atlas Centaur Launch Vehicle; Lightning; Weather; Spacecraft Launching; Flight Hazards; Meteorological Parameters

20000059204 Research and Technology Organization, Information Management Committee, Neuilly-sur-Seine, France
AGARD Index of Publications, 1995-1998 *AGARD Index des Publications, 1995-1998*
April 2000; 610p; In English; CD-ROM contains full text document in PDF format
Report No.(s): RTO-AGARD-INDEX-95-98; AC/323(IMC)TP/1; ISBN 92-837-1038-X; Copyright Waived; Avail: CASI; A99, Hardcopy; A06, Microfiche; C01, CD-ROM

This volume provides abstracts and indexes for AGARD unclassified publications published during the period 1995-1998. Full bibliographical citations and abstracts for all the documents in this publication are given in the abstract section, which is organized in the major subject divisions and specific categories used by NASA in abstract journals and bibliographies. The subject divisions and categories are listed separately, together with a note for each that defines its scope and provides any cross-references. Category breaks in the abstract section are identified by category number and title, and a scope note. Within each category, the abstracts are arranged by document ID number. Six indexes - Subject (based on NASA Thesaurus nomenclature), Personal Author, Panel, Report Number, ISBN and Document ID Number - are included. This publication was sponsored by the Information Management Committee (IMC) of RTO, and compiled by NASA's Center for AeroSpace Information (CASI). This volume completes the series of paper indexes of AGARD publications for 1952-1998.
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Bibliographies; North Atlantic Treaty Organization (NATO); Indexes (Documentation); Aerospace Engineering; Documents; Research and Development; Aerodynamics

20000061448 NASA Langley Research Center, Hampton, VA USA
Development of X-33/X-34 Aerothermodynamic Data Bases: Lessons Learned and Future Enhancements
Miller, C. G., NASA Langley Research Center, USA; Aerodynamic Design and Optimisation of Flight Vehicles in a Concurrent Multi-Disciplinary Environment; June 2000, pp. 32-1 - 32-12; In English; See also 20000061419; Copyright Waived; Avail: CASI; A03, Hardcopy

A synoptic of programmatic and technical lessons learned in the development of aerothermodynamic data bases for the X-33 and X-34 programs is presented in general terms and from the perspective of the NASA Langley Research Center Aerothermodynamics Branch. The format used is that of the "aerothermodynamic chain," the links of which are personnel, facilities, models/test articles, instrumentation, test techniques, and computational fluid dynamics (CFD). Because the aerodynamic data bases upon which the X-33 and X-34 vehicles will fly are almost exclusively from wind tunnel testing, as opposed to CFD, the primary focus of the lessons learned is on ground-based testing. The period corresponding to the development of X-33 and X-34 aerothermodynamic data bases was challenging, since a number of other such programs (e.g., X-38, X-43) competed for resources at a time of downsizing of personnel, facilities, etc., outsourcing, and role changes as NASA Centers served as subcontractors to industry. The impact of this changing environment is embedded in the lessons learned. From a technical perspective, the relatively long times to design and fabricate metallic force and moment models, delays in delivery of models, and a lack of quality assurance to determine the fidelity of model outer mold lines (OML) prior to wind tunnel testing had a major negative impact on the programs. On the positive side, the application of phosphor thermography to obtain global, quantitative heating distributions on rapidly fabricated ceramic models revolutionized the aerothermodynamic optimization of vehicle OMLs, control surfaces, etc. Vehicle designers were provided with aeroheating information prior to, or in conjunction with, aerodynamic information early in the program, thereby allowing trades to be made with both sets of input; in the past only aerodynamic data were available as input. Programmatically, failure to include transonic aerodynamic wind tunnel tests early in the assessment phase led to delays in the optimization phase, as OMLs required modification to provide adequate transonic aerodynamic performance without sacrificing subsonic and hypersonic performance. Funding schedules for industry, based on technical milestones, also presented challenges to aerothermodynamics seeking optimum flying characteristics across the subsonic to hypersonic speed regimes and minimum aeroheating. This paper is concluded with a brief discussion of enhancements in ground-based testing/CFD capabilities necessary to partially/fully satisfy future requirements.
Author
Aerodynamic Characteristics; Aerothermodynamics; Data Bases; Fabrication; Ground Tests; X-33 Reusable Launch Vehicle; X-34 Reusable Launch Vehicle; X-38 Crew Return Vehicle

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SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences.

20000060812 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Guidance and Control for Mars Atmospheric Entry: Adaptivity and Robustness

Lu, Wei–Min, Army Medical Research Lab., USA; Bayard, David S., Jet Propulsion Lab., California Inst. of Tech., USA; [1997]; 6p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In this paper, we address the atmospheric entry guidance and control problem for Mars precision landing. The guidance and control design is based on the principle of tracking a reference drag versus velocity profile in the entry flight corridor, which is determined by physical constraints of the flight. An integrated adaptive/robust control approach to atmospheric entry guidance and control is introduced to deal with different uncertainties.

Author

Adaptive Control; Approach Control; Control Theory; Atmospheric Entry; Mars Atmosphere; Mars (Planet); Mars Landing

Subject Term Index

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